Int. J. Morphol.,
40(4):995-999, 2022.

Common Arterial Trunk for the Branches of the Third Portion of the Axillary Artery. Description of a Case and its Clinical Application

Tronco Arterial Común para las Ramas de la Tercera Porción de la Arteria Axilar. Descripción de un Caso y su Aplicación Clínica

Emilio Farfán C.; Oscar Inzunza H.; Jaritza Tramolao O.; Guillermo Leyton E. & Verónica Inostroza R.

FARFÁN, C. E.; INZUNZA, H. O.; TRAMOLAO, O. J.; LEYTON, E. G. & INOSTROZA, R. V. Common arterial trunk for the branches of the third portion of the axillary artery. Description of a case and its clinical application. *Int. J. Morphol., 40(4)*:995-999, 2022
.

SUMMARY: Variations of the axillary artery may have clinical implications capable of generating unexpected situations during surgical procedures of arterial reconstruction or vascular catheterization. The objective of this work was to report the finding of an anatomical variant of the axillary artery, which may have clinical and surgical implications. A descriptive study was conducted, in which a unilateral vascular variation found during a routine dissection in a right upper limb of a male cadaver was reported. From the second portion of the axillary artery originated a common arterial trunk that gave rise to the subscapular, anterior humeral circumflex, posterior humeral circumflex and deep brachial arteries. The third portion of the axillary artery did not emit branches. The common arterial trunk originated from the second portion, 62.64 mm from the beginning of the axillary artery. Its total length was 23.72 mm and its thickness was 6.1 mm. The caliber of the branches originating from the common arterial trunk was: subscapular artery 5.1 mm, anterior humeral circumflex of 1.66 mm, posterior humeral circumflex 3.18 mm and deep brachial 3.73 mm. The vascular variant detected altered the anatomical relationship of the axillary artery with the brachial plexus, generating a modification in the position of the fascicles and their terminal branches. Anatomical variations of the axillary artery are not infrequent, knowing them may be necessary during surgical procedures or anatomical dissections.

KEY WORDS: Axillary artery; Common arterial trunk; Anatomical variations.

INTRODUCTION

The axillary artery corresponds to the main artery of the axillary fossa, which crosses diagonally from its origin at the outer edge of the first rib to its termination at the level of the inferior edge of the teres major muscle, where it continues with the brachial artery (Goss, 1973; Orts-Llorca, 1985). The traditional description of this artery is in relation to the pectoralis minor muscle, which allows to define three portions for this blood vessel, from the first portion originates the superior thoracic artery, which is distributed by the first two intercostal spaces irrigating the adjacent structures. From the second portion originates the thoracocromial artery distributed by the anterior thoracic and deltoid region, and the lateral thoracic artery that is distributed by the lateral and pectoral thoracic region. From the third portion originates the subscapular artery that corresponds to the branch of greater caliber, which is distributed by the dorsal and scapular region; finally the anterior and posterior humeral circumflex arteries, which supply the shoulder and the upper third of the arm (Rouvière *et al*., 2005; Moore *et al*., 2018).

Inside the axillary fossa the artery establishes relations mainly with the brachial plexus and the axillary vein. The first portion of the axillary artery is related laterally to the posterior fasciculus of the brachial plexus and anteromedially to the axillary vein. The second portion is located between the three fascicles of the brachial plexus, which determines the name of each. In the third portion the axillary artery is related laterally with the lateral fasciculus and the lateral root of the median nerve; medially with the medial fasciculus, the medial root of the median nerve and the ulnar nerve; posteriorly, with the posterior fasciculus,

Department of Anatomy, School of Medicine, Pontificia Universidad Católica de Chile, Chile.

Received: 2022-05-19 Accepted: 2022-06-04

the radial nerve and the axillary nerve. In the second and third portions the artery is medially related to the axillary vein, interposing the branches of the brachial plexus between them (Testut & Latarjet, 1967; Standring, 2016).

Variations of the axillary artery are frequent, and can affect its number, anatomical relationships with the brachial plexus and especially its branching. Variations in the arrangement of its branches are observed in all its portions of the artery; however, they are most often described in the third portion, probably related with the largest number of branches. Among these variations it can be mentioned that in 20 % of cases the anterior and posterior humeral circumflex arteries can originate from a common trunk or in a variable way from the subscapular artery. It can also give rise to branches of the brachial artery, such as the deep brachial, radial and ulnar artery (Gonzalez-Compta, 1991; Aizawa *et al*., 1995; Bigeleisen, 2004; Tubbs *et al*., 2016; Lazaridis *et al*., 2021).

The objective of this work was to report the finding of an anatomical variant of the axillary artery, which may have clinical and surgical implications.

MATERIAL AND METHOD

A descriptive study was conducted, in which a unilateral vascular variation found during a routine dissection in a right upper limb of a 65-year-old male cadaver at the time of his death was reported, which did not present previous surgical interventions in the study region. The specimen was fixed in 10 % buffered formaldehyde and preserved in a refrigerator chamber at 4º C. The body was obtained through the donation program of the Faculty of Medicine of the Pontifical Catholic University of Chile, which fully complies with the Declaration of Helsinki of the World Medical Association and national legal and ethical requirements, in addition the study was approved by the CEC (Scientific Ethics Committee) MED-UC of the Pontifical Catholic University of Chile (No: 190115002).

The dissection procedure was performed by lifting the skin through an incision in the anterior midline in front of the sternum, retracting the skin tissue laterally. The major and minor pectoral muscles were sectioned from their thoracic insertion, being also retracted laterally, which allowed access to the contents of the axillary fossa. While the dissection of the fascicles of the brachial plexus was practiced, an anomalous situation was detected between the fascicles of the brachial plexus and the axillary vessels, generated by an atypical arterial branch. In order to investigate more about this, the dissection of the trunks and terminal branches of the brachial plexus and the axillary artery and its branches was continued. At the end of the dissection, it was possible to recognize a vascular variant from the axillary artery, which altered the anatomical relationships with the brachial plexus and the origin of the vessels belonging to the third portion. The biometric study of the variant artery was also performed.

The dissections were performed with "ad hoc" surgical instrumental and for the measurements of the structures involved in the study a Mitutoyo® digital caliper of 0.01 mm precision was used. For the photographic record was used a Samsung Galaxy S9 equipment with 12 MP camera. The anatomical terms used are based on the International Anatomical Terminology published by the IFAA in 2019 (Federative International Programme for Anatomical Terminology, 2019).

RESULTS

Common arterial trunk variant. The first portion of the axillary artery gave rise to the superior thoracic artery, which was distributed through the first intercostal space. In the second portion, the presence of the thoracocromial and lateral thoracic arteries was confirmed, both originating at the same level, on the medial margin of the pectoralis minor muscle. The thoracocromial artery had its clavicular, acromial, deltoid and pectoral branches, while the lateral thoracic artery was directed towards the anterior thoracic wall distributed through the second and third intercostal spaces. Additionally, in the second portion of the axillary artery, posterior to the pectoralis minor muscle, a large-caliber arterial branch was found. This branch corresponded to a common arterial trunk, from which originated the subscapular artery, anterior humeral circumflex, posterior humeral circumflex and deep brachial in a proximal-distal order. The branching level of this common trunk was equivalent to the level of the third portion of the axillary artery (Fig. 1). The third portion of the axillary artery did not emit any branches and continued distally with the brachial artery.

Biometric study. The axillary artery had a total length of 144.37 mm from its origin to its end. Its initial caliber was 11.24 mm, which was reduced to 5.65 mm after giving rise to the common arterial trunk, ending with 4.87 mm in its final portion.

The common arterial trunk originated from the second portion, 62.64 mm from the beginning of the axillary artery. Its total length was 23.72 mm and its thickness was

6.1 mm. The caliber of the branches originating from the common arterial trunk were: For the subscapular artery 5.1 mm; for the anterior humeral circumflex 1.66 mm; for the posterior humeral circumflex 3.18 mm; and for the deep brachial 3.73 mm.

Anatomical relationships within the axillary fossa. The first portion of the axillary artery was anteriorly related to the axillary vein and posteriorly with the three fascicles of the brachial plexus. The second portion was anteriorly related with the pectoralis minor muscle, posteriorly with the medial fasciculus of the brachial plexus and the medial root of the median nerve, laterally with the common arterial trunk and medially with the axillary vein. The third portion of the axillary artery was anteriorly related with the suspensory ligament of the axilla, posteriorly with the ulnar nerve, laterally with the median nerve, and medially with the axillary vein.

The vascular variation found altered the organization of the terminal branches of the brachial plexus, observing that the medial root of the median nerve was located between the axillary artery and the common arterial trunk (Fig. 2).

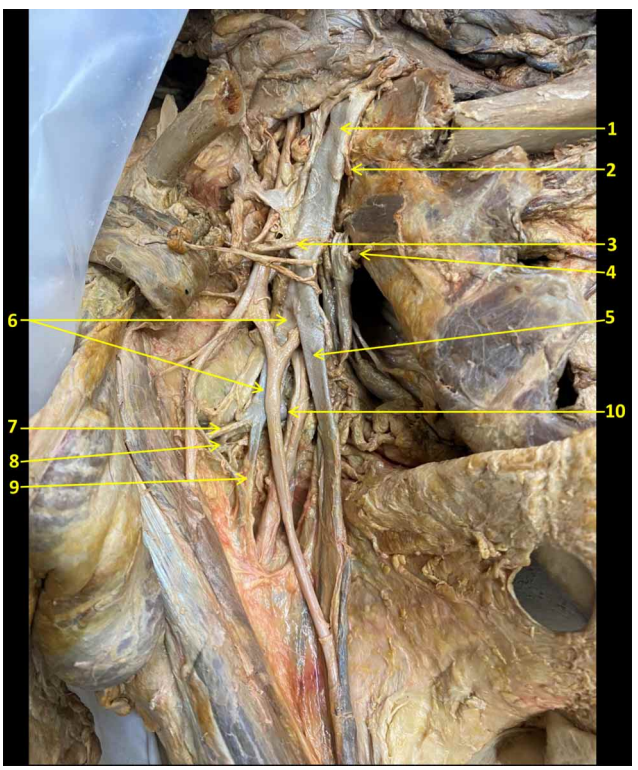

Fig. 1. Anterior view of the right axillary fossa, the branches of the axillary artery are exposed. 1. Axillary A., first portion; 2. Superior thoracic A.; 3. Thoracoacromial A.; 4. Lateral thoracic A.; 5. Axillary A., third portion; 6. Common arterial trunk; 7. Anterior humeral circumflex A.; 8. Posterior humeral circumflex A.; Deep brachial A.; 10. Subscapular A.

The anterior and posterior humeral circumflex arteries originated independently, directed laterally towards the surgical neck of the humerus, the posterior one maintained its path through the quadrangular space next to the axillary nerve. The subscapular artery was medially directed and divided into the circumflex scapular and thoracodorsal arteries. The deep brachial artery reached the radial nerve and together they were directed distally towards the posterior compartment of the arm through the triangular interval (Fig. 2).

Fig. 2. Anterior view of the right axillary fossa, the branches of the axillary artery and their relationship with the brachial plexus are exposed. 1. Axillary A., first portion; 2. Axillary A., third portion; 3. Medial root of the median nerve; 4. Median N.; 5. Subscapular A.; 6. Radial N.; 7. Lateral fasciculus of the brachial plexus; 8. Common arterial trunk; 9. Lateral root of the median nerve; 10. Axillary N. 11. Anterior humeral circumflex A.; 12. Posterior humeral circumflex A.; 13. Deep brachial A.

DISCUSSION

The anatomical variants of the axillary artery have been extensively described by Tubbs *et al*. (2016) in their work "Bergman's Comprehensive Encyclopedia of Human Anatomic Variation", who expose different types of branching of the axillary artery, however none is like the one presented in this article. According to Tubbs *et al*. (2016), variants that include the deep brachial artery as a branch of

the axillary artery originating from the third portion correspond to 13 %, and originating from the posterior humeral circumflex artery in 5 % of cases, but the common arterial trunk reported in this study is not described. The explanation for these situations can be found in embryological development.

The pattern of vascular development is genetically determined (Weinstein, 1999), for this reason an abnormal molecular signal could cause an alteration of the normal course that follows the development of a blood vessel, which could generate the persistence of transient arteries, or the disappearance of arteries that normally persist (Moore *et al*., 2016). This will result in vascular anatomical variation. It should also be considered that the presence of blood vessels, as well as their anatomical position is genetically determined during the early stages of development, however during the late stages their remodeling is influenced by blood flow (Jones *et al*., 2006) or by relationships with neighboring structures, which can also cause anatomical variations.

Regarding the vascularization of the upper limb, it begins in the subclavian artery. Specifically on the right side, the formation of this artery has two origins, one proximal that derives from the fourth pharyngeal arch and another distal that comes from the right dorsal aorta and the seventh right intersegmental artery (Sadler, 2016). In this sense, an alteration in the connection of these primitive vessels, especially of the seventh right intersegmental artery could cause anatomical variations in the axillary artery (Decker *et al*., 1986), as described in this case. In this regard, current studies indicate that the origin of the branches of the axillary artery varies according to the branching patterns, which suggests that these arteries develop simultaneously and their branching patterns may not be random (Yang *et al*., 2021); this hypothesis coincides with our finding, since the vascular variation found consisted in an alterated of the origin of the branches of the third portion of the axillary artery; however, each maintained its territory of vascular distribution.

Clinically, the variations of the axillary artery are relevant due to its size, irrigation territory and the anatomical relationships established with the brachial plexus. In this sense, a positional anomaly could generate difficulties during shoulder surgical procedures, either to perform the exploration of anatomical structures, as well as to perform surgical procedures (Clarke *et al*., 2021; Stone *et al*., 2021). For example, in arterial catheterization procedures to perform cardiac valve replacement, the axillary artery can be used as an alternative access, with special relevance to the caliber of the arterial variant presented here, which is similar to that of the third portion of the axillary artery reported. Similarly, the variable origin of the branches of the common arterial trunk could cause difficulties during post-traumatic arterial reconstruction procedures, both for this artery and for some branch of the brachial plexus.

Regarding aneurysms, usually uncommon in the axillary artery, when these occur they must be treated early as they can derive in thrombosis, distal embolization, symptoms of pressure, rupture or neurological symptoms (Mushtaq *et al*., 2018; Mozafar *et al*., 2020). According to the above, due to the biometric characteristics of the arterial trunk found, an aneurysm in these morphological conditions could generate complications related mainly to neurological symptoms, which could be severe, mainly because the close relationship of the common arterial trunk to the medial fasciculus of the brachial plexus and medial root of the median nerve, which may affect the strength and sensitivity of the forearm and hand. These clinical situations show the importance of knowing this type of variant by specialists, to reduce the risk of incorrect maneuvers that could end in iatrogenies during surgical interventions (Naveen *et al*., 2014; Foley *et al*., 2021).

CONCLUSIONS

The discovery of these anatomical variations in the corpses dissected for teaching purposes in our Department of Anatomy, has an indisputable formative value for undergraduate and postgraduate students, who can verify first-hand the enormous variability of the human being, banishing from their minds the unreal and fictitious archetype presented by the anatomical models, teaching tools widely used today in different medical schools.

DECLARATIONS. Ethics approval and consent to participate. This study was approved by CEC (Comité Ético Científico) MED-UC of the Pontificia Universidad Católica de Chile (No: 190115002).

ACKNOWLEDGEMENTS. The authors thank the people who with great generosity donate their bodies to science, contributing to the development of new professionals.

FARFÁN, C. E.; INZUNZA, H. O.; TRAMOLAO, O. J.; LEYTON, E. G. & INOSTROZA, R. V. Tronco arterial común para las ramas de la tercera porción de la arteria axillar. Descripción de un caso y su aplicación clínica. *Int. J. Morphol., 40(4)*:995-999, 2022.

RESUMEN: Las variaciones de la arteria axilar pueden tener implicancias clínicas capaces de generar situacio-

nes inesperadas durante procedimientos quirúrgicos de reconstrucción arterial o cateterismo vascular. El objetivo de este trabajo fue reportar el hallazgo de una variante anatómica de la arteria axilar, la cual puede tener implicancias clínicas y quirúrgicas. Se realizó un estudio de tipo descriptivo, en el cual se reportó una variación vascular unilateral encontrada durante una disección de rutina en un miembro superior derecho de un cadáver de sexo masculino. De la segunda porción de la arteria axilar se originó un tronco arterial común que daba origen a las arterias subescapular, circunfleja humeral anterior, circunfleja humeral posterior y braquial profunda. La tercera porción de la arteria axilar no emitía ramas. El tronco arterial común se originaba de la segunda porción, a 62,64 mm del inicio de la arteria axilar. Su longitud total era de 23,72 mm y su grosor de 6,1 mm. El calibre de las ramas originadas del tronco arterial común fue: arteria subescapular 5,1 mm, circunfleja humeral anterior de 1,66 mm, circunfleja humeral posterior 3,18 mm y braquial profunda 3,73 mm. La variante vascular detectada alteraba las relaciones anatómicas de la arteria axilar con el plexo braquial, generando una modificación en la posición de los fascículos y sus ramos terminales. Las variaciones anatómicas de la arteria axilar son frecuentes, conocerlas puede ser necesario durante procedimientos quirúrgicos o disecciones anatómicas.

PALABRAS CLAVE: Arteria axillar; Tronco arterial común; Variación anatómica.

REFERENCES

Aizawa, Y.; Ohtsuka, K. & Kumaki, K. Examination on the courses of the arteries in the axillary region I. The course of the subscapular artery system, especially the relationships between the arteries and the posterior cord of the brachial plexus. Kaibogaku Zasshi, 70(6):554-68, 1995.

Bigeleisen, P. E. The bifid axillary artery. *J. Clin. Anesth., 16(3)*:224-5, 2004.

Clarke, E.; Tubbs, R. S.; Radek, M.; Ha?adaj, R.; Tomaszewski, M. & Wysiadecki, G. Unusual formation of the musculocutaneous and median nerves: a case report refined by intraneural dissection and literature review. *Folia Morphol. (Warsz.), 80(4)*:1020-6, 2021.

Decker, G. A. G.; du Plessis, D. J. & McGregor, L. *Synopsis of Surgical Anatomy*. 12th ed. Mumbai, K. M. Varghese Company, 1986.

Federative International Programme for Anatomical Terminology (FIPAT). *Terminologia Anatomica.* Halifax, Dalhousie University, 2019. Disponible en: https://fipat.library.dal.ca

Foley, J.; Elamien, A. & McCann, B. Axillary artery and brachial plexus injury secondary to blunt trauma. *J. Surg. Case Rep., vol. 2021(3)*:rjab068, 2021.

Gonzalez-Compta, X. Origin of the radial artery from the axillary artery and associated hand vascular anomalies. *J. Hand Surg. Am., 16(2)*:293-6, 1991.

Goss, C. (Ed.). *Anatomy of the Human Body*. 29th ed. Philadelphia, Lea & Febiger, 1973.

Jones, E. A. V.; le Noble, F. & Eichmann, A. What determines blood vessel structure? Genetic prespecification vs. hemodynamics. *Physiology (Bethesda), 21*:388-95, 2006.

Lazaridis, N.; Piagkou, M.; Aidonis, I.; Paraskevas, G.; Sofidis, G. & Natsis, K. Unusual axillary artery branching pattern associated with multiple neural variations. *Acta Med. Acad., 50(3)*:393-6, 2021.

Moore, K. L.; Dalley, A. F. & Agur, A. M. R. *Anatomía con orientación clínica.* 8th ed. Philadelphia, Wolters Kluwer, 2018.

Moore, K.; Persaud, T. & Torchia, M. *Embriología Clínica*. 10th ed. Barcelona, Elsevier, 2016.

Mozafar, M.; Zarrintan, S. & Parvas, E. Axillary artery aneurysm in a 3-year-old child: a rare case and review of the literature. *Ann. Vasc. Surg., 62*:499.e1-499.e4, 2020.

Mushtaq, S.; Shah, I. & Bashir, E. A. Axillary artery aneurysm. *J. Coll. Physicians Surg. Pak., 28(6)*:S84-S86, 2018.

Naveen, K.; Jyothsna, P.; Nayak, S. B.; Mohandas, R. K. G.; Swamy, R. S.; Deepthinath, R. & Shetty, S. D. Variant origin of an arterial trunk from axillary artery continuing as profunda brachii artery--a unique arterial variation in the axilla and its clinical implications. *Ethiop. J. Health Sci., 24(1)*:93-6, 2014.

Orts-Llorca, F. *Anatomía Humana*. Vol. 1. 6a ed. Barcelona, Científico-Médica, 1985.

Rouvière, H.; Delmas, A. & Delmas, V. *Anatomía Humana. Descriptiva, Topográfica y Funcional.* Vol. 3. 11ª ed. Barcelona, Masson, 2005.

Sadler, T. Langman Embriología Médica. 13ª ed. Barcelona, Wolters Kluwer, 2016.

Standring, S. *Gray's Anatomy. The Anatomical Basis of Clinical Practice.* 41a ed. New York, Elsevier, 2016.

Stone, M. A.; Ihn, H. E.; Gipsman, A. M.; Iglesias, B.; Minneti, M.; Noorzad, A. S. & Omid, R. Surgical anatomy of the axillary artery: clinical implications for open shoulder surgery. *J. Shoulder Elbow Surg., 30(6)*:1266-72, 2021.

Testut, L. & Latarjet, A. *Anatomía Humana*. Vol. 1. Osteología-Artrología-Miología. 9a ed. Barcelona, Salvat, 1967.

Tubbs, R. S.; Shoja, M. M. & Loukas, M. *Bergman's Comprehensive Encyclopedia of Human Anatomic Variation*. New Jersey, Wiley Blackwell, 2016.

Weinstein, B. M. What guides early embryonic blood vessel formation? *Dev. Dyn., 215(1)*:2-11, 1999.

Yang, K.; Lee, H.; Choi, I. J.; Jeong, W.; Kim, H. T.; Wei, Q. & Lee, J. H. Topography and Anatomical Variations of the Axillary Artery. *Biomed Res. Int., 2021*:6393780, 2021.

Corresponding author:
Dr. Emilio Farfán Cabello
Departamento de Anatomía
Escuela de Medicina
Pontificia Universidad Católica de Chile
Av. Libertador Bernardo O'Higgins #340
Santiago
CHILE

E-mail: efarfanc@uc.cl