

Aberrant Branches of the Subclavian Artery and their Relationship with the Phrenic Nerve and the Brachial Plexus

Ramas Aberrantes de la Arteria Subclavia y su Relación con el Nervio Frénico y el Plexo Braquial

Yong Zheng, Huibin Wang, Yating Liu, Aiyang Zhao, Xinyu Pan, Yaohui Guo & Yueshan Lei

ZHENG, Y.; WANG, H.; LIU, Y.; ZHAO, A.; PAN, X.; GUO, Y. & LEI, Y. Aberrant branches of the subclavian artery and their relationship with the phrenic nerve and the brachial plexus. *Int. J. Morphol.*, 40(2):433-435, 2022.

SUMMARY: Variations in subclavian artery branches are relatively common and may impact surgical procedures and effects. During educational dissection of a male cadaver, we encountered an extremely rare variation of the right subclavian artery branches. The internal thoracic artery, the thyrocervical trunk, and the costocervical trunk arose from the third part of the right subclavian artery. In addition, the phrenic nerve displaced remarkably laterally by the thyrocervical trunk, and the course of the costocervical trunk was between the upper trunk and the middle trunk of the brachial plexus. These variations may pose a potential risk for nerve compression and increase the risk of arterial and nerve puncture. This case report would bring attention to the possibility of other similar cases, and early detection of these variations through diagnostic interventions is helpful to reduce postoperative complications.

KEY WORDS: Transverse cervical artery; Costocervical trunk; Internal thoracic artery; Phrenic nerve; Brachial plexus.

INTRODUCTION

The subclavian arteries supply blood to the upper limbs and send branches to the neck, thorax, and brain. According to anatomical textbooks and the previous studies, each subclavian artery is divided into three parts, The first part extends from the origin of the subclavian artery to the medial margin of the anterior scalene muscle, the second part lies behind the anterior scalene muscle, and the third part extends from the lateral margin of the anterior scalene muscle to the lateral margin of the first rib (Bean, 1905). Generally, there are five branches of the subclavian artery: the vertebral artery, the internal thoracic artery, and the thyrocervical trunk, the costocervical trunk (Takafuji & Sato, 1991).

The variations of the subclavian branches are known to influence clinical operation (Andreou *et al.*, 2011). Based upon previously reported cases, all branches arise from the first part of the subclavian artery, except in the case of the costocervical trunk on the right subclavian artery (Takafuji & Sato). In this report, the internal thoracic artery, the thyrocervical trunk, and the costocervical trunk arose from

the third part of the right subclavian artery, the phrenic nerve displaced laterally to the thyrocervical trunk, and the brachial plexus encircled the costocervical trunk. We report this case to bring attention to the possibility of other similar cases, it is helpful to understand the anatomic variants of the subclavian branch, and decrease the risk of iatrogenic injury during neck procedures.

CASE REPORT

During a routine educational dissection in the Human Body Course, a male cadaver of unknown age was presented with aberrant subclavian branches which were carefully dissected to identify their courses and photographed.

The first part of the right subclavian artery gave off the vertebral artery. At the second part, the subclavian artery gave off no branch. The costocervical trunk (75.3 mm from the origin of the subclavian artery, with a 2.6 mm diameter),

the thyrocervical trunk (81.6 mm from the origin of the subclavian artery, with a 3.1 mm diameter), and the internal thoracic artery (87.6 mm from the origin of the subclavian artery, with a 2.5 mm diameter) were ramified at the third part of the right subclavian artery. The costocervical trunk arose from the upper part of the subclavian artery

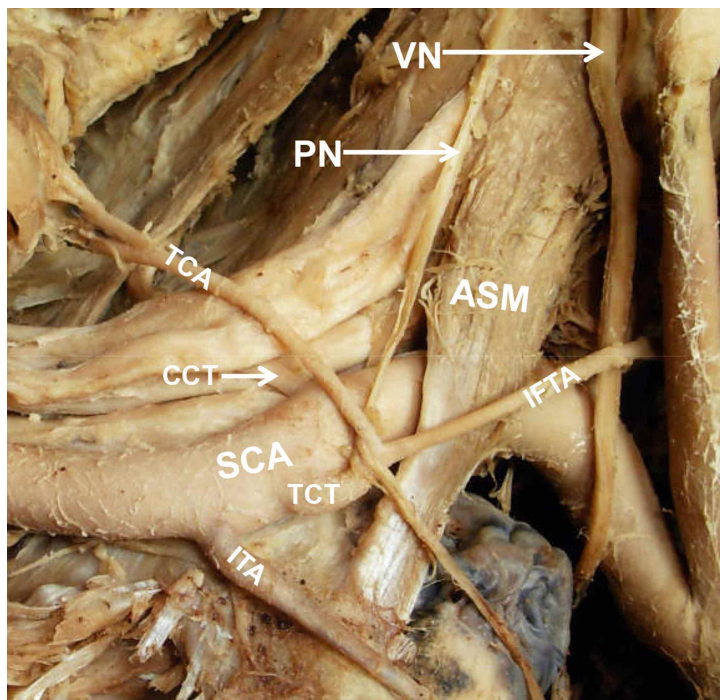


Fig. 1. The branches of the right subclavian artery (SCA): The third part of the right SCA divided into the costocervical trunk (CCT), the thyrocervical trunk (TCT), and the internal thoracic artery (ITA); the phrenic nerve (PN) displaced laterally to the TCT; The CCT was encircled by the brachial plexus; the vagus nerve (VN); the anterior scalene muscle (ASM); the inferior thyroid artery (IFTA); the transverse cervical artery (TCA).

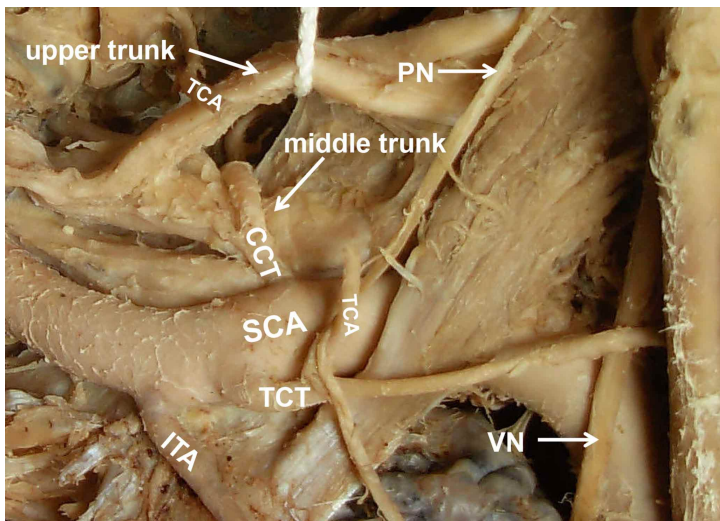


Fig. 2. Enlarged view from the third part of the right SCA: The CCT arose from the upper part of the SCA and passed between the upper trunk and the middle trunk of the brachial plexus.

and passed between the upper trunk and the middle trunk of the brachial plexus. The thyrocervical trunk is a short vessel and it divides after its origin into two branches: the inferior thyroid artery and the transverse cervical artery. the inferior thyroid artery was found to pass in front of the scalenus anterior muscle, and the transverse cervical artery crossed in front of the upper trunk of the brachial plexus.

The right phrenic nerve arose from the fourth cervical nerve, descended along the lateral side of the anterior scalene muscle, then crossed behind the transverse cervical artery and descended passing the lateral side of the thyrocervical trunk downward into the chest. Therefore, the phrenic nerve was pulled obviously and bent at an angle of 120 because the aberrant course passing the outside of the thyrocervical trunk.

DISCUSSION

Ramification patterns of the subclavian branches have been reported by Uemura *et al.* (2010), while, there was no instance of the costocervical trunk, the thyrocervical trunk, and the internal thoracic artery were originating from the third part of the right subclavian artery. By study in 144 subclavian arteries, Takafuji & Sato reported that 3 unusual cases (2.1 %) in which the internal thoracic artery branched independently from the third part, none of cases in which the costocervical trunk and the thyrocervical trunk originating from the third portion directly. The phenomenon of the costocervical trunk, the thyrocervical trunk, and the internal thoracic artery originating from the third part of the ordinary subclavian artery is extremely rare.

The phrenic nerve is primarily supplied by the fourth cervical nerve, and descends obliquely across the anterior scalene toward the thorax (Jiang *et al.*, 2011). Multiple anatomic variants of the phrenic nerve in the neck have been described, such as duplicated phrenic nerves, accessory phrenic nerve, and medially or laterally displaced phrenic nerves (Ogami *et al.*, 2016). As reported by Golarz & White (2020) anatomic variations of the phrenic nerve were identified in 28 (28 %) patients. This variable course of the phrenic nerve increases the complexity of the surgical procedure performed in the neck (Lee *et al.*, 2021). In the present case, these

variations of the subclavian arteries and the phrenic nerve existing more laterally than usual. Therefore, the phrenic nerve might be pulled and temporary dyspnea might be induced because of the movement of the neck and upper limb.

In conclusion, we described some rare variations, such as their origin of the internal thoracic artery, the thyrocervical trunk, and the costocervical trunk, the phrenic nerve displaced laterally to the thyrocervical trunk, and the course of the costocervical trunk is between the upper trunk and the middle trunk of the brachial plexus. Variations in subclavian artery anatomy are known to influence surgical procedures and effects. Although, modern imaging technology are often used for the accurate examination (Bulbul *et al.*, 2019), it is still possible that rare variations may be overlooked. Therefore, these rare variations should be kept in mind and bring attention to the possibility of other similar cases.

ACKNOWLEDGMENTS

This work was supported by grants from Wuhan University Undergraduate Education Quality Comprehensive Reform Project (Grant No: 2022ZG191) and Teaching Innovation Program of Wuhan University School of Medicine (Grant No: 2020007).

ZHENG, Y.; WANG, H.; LIU, Y.; ZHAO, A.; PAN, X.; GUO, Y. & LEI, Y. Ramas aberrantes de la arteria subclavia y su relación con el nervio frénico y el plexo braquial. *Int. J. Morphol.*, 40 (2):433-435, 2022.

RESUMEN: Las variaciones en las ramas de la arteria subclavia son relativamente comunes y pueden afectar los procedimientos y efectos quirúrgicos. Durante la disección educativa de un cadáver masculino, encontramos una variación extremadamente rara de las ramas de la arteria subclavia derecha. La arteria torácica interna, el tronco tirocervical y el tronco costocervical nacían de la tercera parte de la arteria subclavia derecha. Además, el nervio frénico se desplazaba lateralmente por el tronco tirocervical, y el trayecto del tronco costocervical se encontraba entre el tronco superior y el tronco medio del plexo braquial. Estas variaciones pueden suponer un riesgo potencial de compresión nerviosa y aumentar el riesgo de punción arterial y nerviosa. Este reporte de caso llamaría la atención sobre la posibilidad de otros casos similares, y la detección temprana de estas variaciones a través de diagnósticos es útil para reducir las complicaciones postoperatorias.

PALABRAS CLAVE: Arteria cervical transversa; Tronco costocervical; Arteria torácica interna; Nervio frénico; Plexo braquial.

REFERENCES

- Andreou, A. Y.; Iakovou, I.; Vasiliadis, I.; Psathas, C.; Prokavas, E. & Pavlides, G. Aberrant left internal thoracic artery origin from the extrascapular part of the subclavian artery. *Exp. Clin. Cardiol.*, 16(2):62-4, 2011.
- Bean, R. B. A composite study of the subclavian artery in man. *Am. J. Anat.*, 4(3):303-28, 1905.
- Bulbul, E.; Yanik, B.; Kay, E.A.; Koksall, V. & Demirpolat, G. Arterial variations within the lateral cervical region: a multidetector CT angiography study. *Int. J. Morphol.*, 37(3):991-6, 2019.
- Golarz, S. R. & White, J. M. Anatomic variation of the phrenic nerve and brachial plexus encountered during 100 supraclavicular decompressions for neurogenic thoracic outlet syndrome with associated postoperative neurologic complications. *Ann. Vasc. Surg.*, 62:70-5, 2020.
- Jiang, S.; Xu, W. D.; Shen, Y. D.; Xu, J. G. & Gu, Y. D. An anatomical study of the full-length phrenic nerve and its blood supply: clinical implications for endoscopic dissection. *Anat. Sci. Int.*, 86(4):225-31, 2011.
- Lee, J. H.; Kim, H. T.; Choi, I. J.; Heo, Y. R. & Jung, Y. W. An unusual anatomical variant of the left phrenic nerve encircling the transverse cervical artery. *Folia Morphol. (Warsz.)*, 80(4):1027-31, 2021.
- Ogami, K.; Saiki, K.; Okamoto, K.; Wakebe, T.; Manabe, Y.; Imamura, T. & Tsurumoto, T. Marked lateral deviation of the phrenic nerve due to variant origin and course of the thyrocervical trunk: a cadaveric study. *Surg. Radiol. Anat.*, 38(4):485-8, 2016.
- Takafuji, T. & Sato, Y. Study on the subclavian artery and its branches in Japanese adults. *Okajimas Folia Anat. Jpn.*, 68(2-3):171-85, 1991.
- Uemura, M.; Takemura, A.; Ehara, D.; Yasumitsu, H.; Ohnishi, Y. & Suwa, F. Comparative study of the ramification patterns of the subclavian branches as the subclavian artery passes in front or behind the scalenus anterior muscle. *Anat. Sci. Int.*, 85(3):160-6, 2010.

Corresponding author:

Dr. Yueshan Lei
Department of Anatomy and Embryology
Wuhan University TaiKang Medical School
(School of Basic Medical Sciences)
Wuhan University
185 Donghu Road
Wuhan Hubei 430071
CHINA

E-mail: lysh9638@163.com
lysh9638@whu.edu.cn