A case of retroesophageal right subclavian artery, with special reference to the second intercostal artery, retroesophageal right vertebral artery, and thoracic duct

Keishi Okamoto, Tetsuaki Wakebe, Kazunobu Saiki, Toshiyuki Tsurumoto

Department of Macroscopic Morphology, Unit of Basic Medical Sciences, Graduate School of Biomedical Science, Nagasaki University, Nagasaki, Japan

Short running title:
retroesophageal right subclavian artery

Address correspondence to:
Keishi Okamoto
Department of Macroscopic Morphology, Unit of Basic Medical Sciences,
Graduate School of Biomedical Science, Nagasaki University
1-12-4 Sakamoto, Nagasaki 852-8523, Japan.
Email: okamon@nagasaki-u.ac.jp
Fax: 095-819-7024
Tel.: 095-819-7022

Abstract

We report a case of retroesophageal right subclavian artery identified in a 59-year-old Japanese female during routine dissection in Nagasaki University School of Medicine. This kind of variation is relatively rare; however, reports of such cases have accumulated. We paid attention to the intersegmental arteries and above all, the second intercostal artery. On the other hand, there have been reports of a retroesophageal right vertebral artery, although such cases are extremely rare. It is considered that both retroesophageal arteries are formed by similar mechanisms. In other words, the distal part of the right dorsal aorta remained in such cases. However, in the case of a retroesophageal right vertebral artery, there might be the possibility of intercostal arteries developing into the vertebral artery. We discuss such points.

Introduction

A retroesophageal right subclavian artery which branches off from the aortic arch as its last branch is relatively rare. However, studies on such cases have often been reported (Hasebe, 1912; Adachi, 1928; Kasai, 1979). For example, Chiba et al. (1981) summarized the findings in 94 of such cases reported in Japan and, recently, Sakamoto et al. (2012) detected a case based on CT images before dissection, and they verified it on dissection. Developmentally, Barry's explanation (1951) has been widely accepted. According to it, the retroesophageal right subclavian artery is formed by remaining of the right dorsal aorta. Recently, Kawai et al. (2011) proposed precise schematic diagrams on the morphogenesis of the retroesophageal right subclavian artery based on five examples. On the other hand, the retroesophageal right vertebral artery which arises from the aortic arch as its last branch is very rare (Kemmentmüller, 1911; Nakaba, 1976; Sakamoto, 1980; Higashi et al. 2008). Both retroesophageal arteries have been said to show the same developmental background (Sakamoto, 1980; Higashi et al. 2008). However, Kumaki and Yamada (1979) suggested another possibility of morphogenesis in the case of the retroesophageal right vertebral artery, paying attention to the intersegmental arteries. We report a case of retroesophageal right subclavian artery, together with a second intercostal artery, bronchial artery, and the thoracic duct. The present research was performed on a donated cadaver to our institution for student dissection and research. The present work does not contain any ethical problems from the view-points of the Declaration of Helsinki in 1995 which was revised in Edinburgh 2000.

Case report

A case of retroesophageal right subclavian artery arising from the aortic arch as its last branch was found in a 59-year-old Japanese female during dissection practice at Nagasaki University School of Medicine in 2006. In this case the aortic arch branched off the right common carotid artery, left common carotid artery, and left subclavian artery and then, after a short distance, the right subclavian artery arose from the aortic arch from its right wall at the height of the 3rd thoracic vertebra. The right subclavian artery then passed behind the esophagus obliquely to the right-upwards and anterior to the thoracic vertebra (Figs. 1, 2). Then, it branched off the right vertebral artery, thyreocervical artery, internal thoracic artery, and costocervical trunk and then entered the scalene space. The right vertebral artery entered the sixth transverse foramen of the cervical vertebra. Near this artery, a small branch entered the seventh transverse foramen of the cervical vertebra (Figs. 3, 4). On both sides the supreme intercostal artery distributed only to the first intercostal space. The second intercostal artery came from the thoracic aorta on both sides. The right second intercostal artery had the bronchial artery and prevertebral branches. The right recurrent nerve was not formed. We could not precisely examine the cardiac nerves. The thoracic duct bifurcated a little below the right subclavian artery, and the left branch went to the left venous angle, passing behind the right subclvian artery. The right branch went to the right venous angle together with the right subclavian artery (Figs. 5, 6).

Discussion

The retroesophageal right subclavian artery occurs developmentally with the remaining of the right dorsal aorta (distal part) and disappearance of the right fourth branchial arch (Broman, 1908; Barry, 1951). However, it has small defects concerning the intersegmental arteries and longitudinal anastomoses between them. Recently Kawai et al. (2011) paid attention not only to the intersegmental arteries and their longitudinal anastomosis but also to the bronchial artery and thoracic duct. Then, they showed them by precise schematic diagrams in order to understand the retroesophageal right subclavian artery comprehensively. We paid attention to the highest intercostal artery from the thoracic aorta and noticed a tendency in which the highest intercostal artery was the second intercostal artery. Usually, the second intercostal artery comes from the supreme intercostal artery. This tendency should be checked in similar cases of the retroesophageal right subclavian artery. If it is true, it may be related to the remaining of the distal part of the dorsal aorta. On the other hand, the right bronchial artery usually branches off from the highest intercostal artery from the thoracic aorta. In our case, it came from the second intercostal artery and not from the retroesophageal right subclavian artery. The bronchial artery may be regarded as the mediastinal branch of the intersegmental artery, as Patten (1972) showed. In the case of the retroesophageal right subclavian artery, the thoracic duct has a tendency to enter into the right venous angle and not only to the left. This relation may also be interesting. The right thoracic duct runs along the retroesophageal right subclavian artery and the left thoracic duct goes ahead behind the retroesophgeal right subclavian artery, whereas the thoracic duct usually passes in front of the right intercostal arteries (Figs. 5, 6). As a very rare case, a retroesophgeal right vertebral artery has been reported (Kemmentmüller, 1911; Nakaba, 1976; Sakamoto, 1980; Higashi et al. 2008). Such cases have been explained to be formed by a similar developmental mechanism with the retroesophageal right subclavian artery as mentioned above at the beginning of this discussion. However, Kumaki and Yamada (1979) suggested two kinds of derivation in the case of the retroesophageal right vertebral artery. In the other derivation, an intersegmental artery plays an important role. When we observed the retroesophageal right vertebral artery reported by Higashi et al. (2008), we suggested that this artery resembled the second intercostal artery other than the retroesophgeal right subclvian artery in our case. In order to distinguish between the two kinds of derivation, the thoracic duct may offer a clue. When the

thoracic duct passes in front of the retroesophgeal right vertebral artery, it may be derived from the intercostal artery. When the thoracic duct passes behind the retroesophageal right vertebral artery it may be derived from the right dorsal aorta. So, it may be better to examine the positional relation between the thoracic duct and anomalous right vertebral artery from the aortic arch.

Conflict of interest None

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Figure Legends

Fig. 1　A retroesophageal right subclavian artery as the last branch of the aortic arch (59-year-old Japanese female).

Fig. 2　A cross vision stereoscopic photograph of Fig. 1

Fig. 3　The esophagus was reflected downwards and the aortic arch was reflected towards the left side to show the origin and course of the retroesophageal right subclavian artery.

Fig. 4　A cross vision stereoscopic photograph of Fig. 3

Fig. 5　The intercostal arteries, bronchial arteries, thoracic duct, and azygos vein are shown.

Fig. 6　A cross vision stereoscopic photograph of Fig. 5

Abbreviations in the Figures:

Ao, aortic arch; Az, azygos vein; br, bronchial artery; CC, common carotid artery (-d, right; -s, left); C7, 7th transverse foramen; Du, thoracic duct; Es, esophagus; PA, pulmonary artery; Sb, subclavian artery, Th2, 2nd intercostal artery; Th3, 3rd intercostal artery; Tr, trachea; Thyr, thyroid gland; VA, vertebral artery; Ⅰ - Ⅲ, first to third rib;　Ⅵ, 6th cervical vertebra; X, vagus nerve

Fig. 1

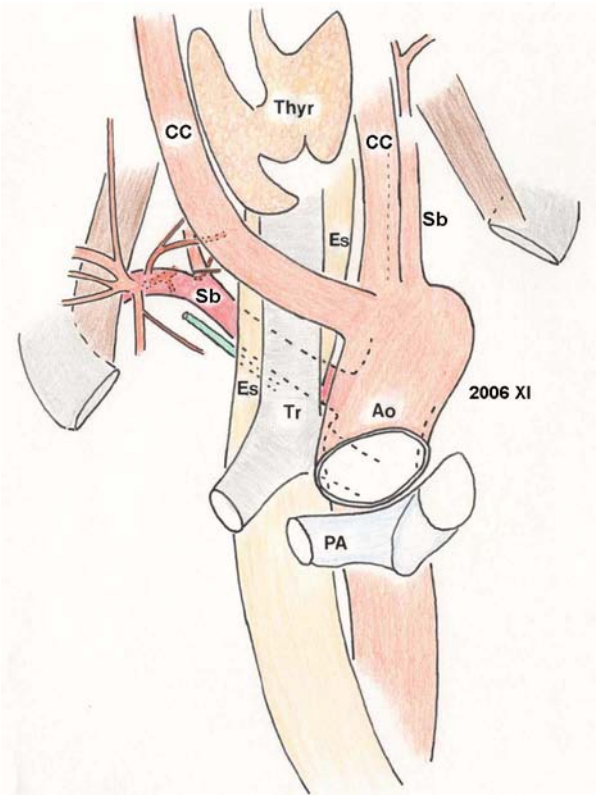

Fig. 2

Fig. 3

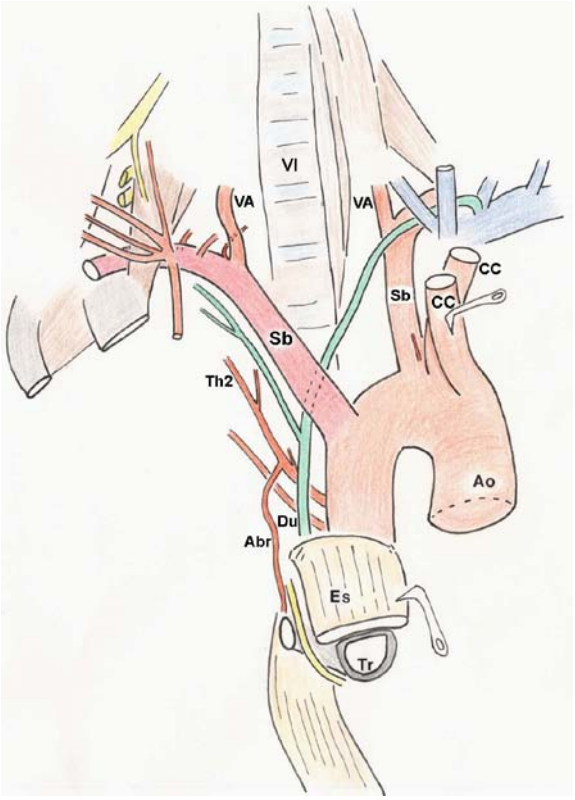

Fig. 4

Fig. 5

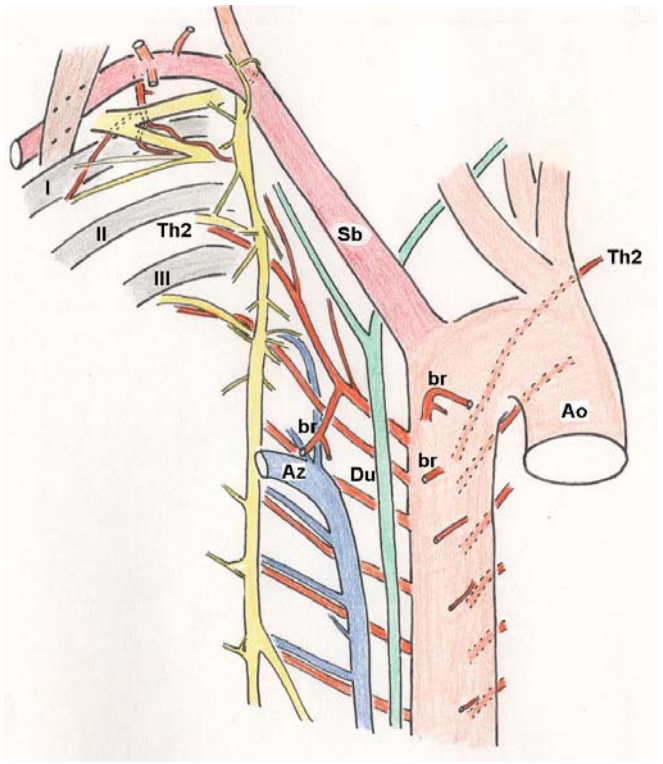

Fig. 6