

Anatomical variation of the aortic arch branches: A case report and literature review

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ABSTRACT

Anatomical variations of the aortic arch branches have been documented; however, the occurrence of five branches arising directly from the aortic arch is rare. During the dissection of a 35-year-old male cadaver's thorax and neck region for undergraduate students in the academic year 2022–2023 at the Department of Anatomy, Faculty of Medicine, Delta College of Science and Technology, Omdurman City, Sudan, the aortic arch exhibited five direct branches: the left subclavian, left common carotid, left vertebral, right common carotid, and right subclavian arteries. Understanding such variations and their anatomical courses prior to surgical procedures holds significant clinical value.

Keywords: Anatomical variations, aortic arch, vertebral artery, subclavian artery.

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INTRODUCTION

The aortic arch is a continuation of the ascending aorta, expanding from the level of the angle of Louis at the second right sternocostal joint. It curves in the superior mediastinum, moving superiorly, posteriorly, and inferiorly before continuing as the descending aorta at the level of the second left sternocostal joint.¹ The aortic arch branches have been observed in 5.3% of 320 angiographic cases in South Africa.² A study by Nayak et al. reported that the classical branching pattern of the aortic arch was present in 91.4% of 62 cases.³ In a Chinese study involving 120 cadavers, the majority (106) exhibited the typical aortic arch branches, while 14

displayed two basic types of branch variations, accounting for an incidence of 11.67%.⁴

A study of 58 specimens found that the aortic arch provided three normal branches in 77.3% of cases, while two branches were present in 14.66%. In one instance, the left common carotid artery and brachiocephalic trunk arose from a common trunk. Additionally, six (8%) aortic arches exhibited a direct archorigin of the left vertebral artery.⁵

CASE PRESENTATION

During the dissection of a 35-year-old male cadaver for undergraduate students in the academic year 2022–

2023 at the Department of Anatomy, Faculty of Medicine, Delta College of Science and Technology in Omdurman City, Sudan, the thoracic cage and neck were dissected according to Cunningham's manual guidelines. The skin, underlying muscles, and viscera were removed and preserved. The rib cage was opened, exposing the heart and great vessels, while the neck was dissected to explore the vessels and soft structures. An anatomical variation of the aortic arch branches was identified. The aortic arch exhibited five direct branches: the left subclavian, left common carotid, left vertebral, right common carotid, and right subclavian arteries. A unilateral left vertebral artery was observed arising from the aortic arch just to the right of the left

subclavian artery. The right common carotid, and right subclavian arteries originated directly from the arch of the aorta, indicating the absence of the brachiocephalic artery. The right subclavian artery arose from the left side of the aortic arch, deep to the other branches, and passed obliquely behind the esophagus for about 3.95 cm until it reached the back of the sternoclavicular joint, continuing along the outer border of the first rib to become the axillary artery. The right common carotid artery arose from the right side of the aortic arch and extended for about 2.42 cm before passing behind the sternoclavicular joint to reach the right side of the neck. The left common carotid and left subclavian arteries arose normally from the aortic arch.



Figure 1: Branches of the aortic arch from anterior view: ascending aorta (A.A), aortic arch (A.AR), left subclavian artery (L-SA), left common carotid artery (L-CCA), left vertebral artery (L-VA), right common carotid artery (R-CCA), right subclavian artery (R-SA), and pulmonary trunk (PU-T).



Figure 2: Inner view showing branches of the aortic arch from posterior view after reflecting the aortic arch: ascending aorta (A.A), aortic arch (A.AR), left subclavian artery (L-SA), left common carotid artery (L-CCA), left vertebral artery (L-VA), right common carotid artery (R-CCA), and right subclavian artery (R-SA).

DISCUSSION

In anatomical literature, the aortic arch typically gives rise to three branches: the left subclavian artery, left common carotid artery, and brachiocephalic trunk. Numerous studies have documented variations in the branching patterns of the aortic arch. During the embryonic development of the aortic arch and its branches, anomalies may arise due to the absence or persistence of certain parts of the aortic arch that are normally absent, or the disappearance of parts that are typically present.⁶ In a rare case involving a 55-year-old South Indian male, the aortic arch gave rise to an unusual common trunk for the brachiocephalic trunk and left common carotid artery, with the brachiocephalic trunk bifurcating into the right common carotid artery, right vertebral artery, and right subclavian artery.⁷ Reports have documented two common trunks arising from the arch: one giving rise to the left common carotid and brachiocephalic arteries, and the other to the left vertebral and left subclavian arteries.⁸ In an 80-year-old Japanese male cadaver, the right subclavian artery originated from the aortic arch distal to the left subclavian artery.⁹

In a case report, five branches were observed originating from the arch of the aorta: two vertebral arteries in addition to the brachiocephalic, left subclavian, and left common carotid arteries.¹⁰ In another case report, five branches were described as arising from the arch of the aorta: two left vertebral arteries in addition to the brachiocephalic, left subclavian, and left common carotid arteries.¹¹

In a rare instance, Ma et al. identified five aortic arch arterial branches: right common carotid, left common carotid, left thyrocervical trunk, and right subclavian, organized from right to left.¹²

In the current rare case, the aortic arch exhibited five direct branches: the left subclavian, left common carotid, left vertebral, right common carotid, and right subclavian arteries, as seen in Figures 1 and 2. The absence of the brachiocephalic artery resulted in the right common carotid and right subclavian arteries arising directly from the aortic arch. The right subclavian artery arose from the left side of the aortic arch, deep to the other branches, and coursed obliquely posterior to the esophagus, which may expose it to compression by surrounding structures, potentially affecting blood flow.

In six out of 58 (8%) cases, the left vertebral artery arises as a direct branch from the aortic arch.⁵ Bilateral vertebral arteries have been noted to arise directly from the arch in a 60-year-old male.¹³ In another case, the left vertebral artery originated from the aortic arch between the left common carotid artery and the left subclavian artery.¹⁴ A vertebral artery was also observed originating from the arch of the aorta on the left side.¹⁵

In contrast to the findings in this case, the left vertebral artery originated directly from the aortic arch (Figure 2), while the right vertebral artery followed the normal anatomy course and origin from the first part of the subclavian artery.

CONCLUSIONS

In the current case, the aortic arch was noted to give rise directly to five branches: the left subclavian, left common carotid, left vertebral, right common carotid and right subclavian arteries. It was understood that variations in the aortic arch are crucial in the context of surgical interventions and approaches. Therefore, understanding such kinds of these variations and their anatomical courses prior to surgical procedures holds significant clinical value.

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