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Aberrant right subclavian artery with an additional arterial branch variation – a cadaveric case report

Аберантна десна поткључна артерија са додатном артеријском граном – кадаверични приказ случаја

SUMMARY

Introduction Variations in the branching pattern of the aortic arch constitute important anatomical differences with implications for surgical interventions involving the head, neck, and upper extremities, as well as for endovascular procedures and radiological evaluations. The aim of this study was to present a retroesophageal aberrant right subclavian artery accompanied by an additional arterial branch identified during routine cadaveric dissection.

Case Outline The branching pattern of the aortic arch was examined during the thoracic dissection of a 69-year-old male cadaver used for educational purposes at the Department of Anatomy, Faculty of Medicine, Kafkas University. Examination revealed the absence of the brachiocephalic trunk. The aortic arch gave rise sequentially to the right common carotid artery, left common carotid artery, and left subclavian artery. The right subclavian artery originated from the distal portion of the aortic arch and coursed posterior to the esophagus before passing to the right side and continuing toward the upper limb. In addition, an additional arterial branch arising from the right subclavian artery was identified. This branch coursed superior to the anterior scalene muscle and rejoined the right subclavian artery distally.

Conclusion An aberrant right subclavian artery is a rare but clinically significant vascular variation. In cases exhibiting a retroesophageal course, it may cause various clinical manifestations, particularly dysphagia. Furthermore, altered anatomical relationships may result in diagnostic and surgical challenges during thoracic surgery, vascular interventions, and radiological procedures. The presence of an additional arterial branch accompanying the aberrant right subclavian artery in the present case highlights the diversity of vascular variations in the upper extremity. Awareness of such variations is important for preventing potential complications during diagnostic and interventional procedures.

Keywords: arteria lusoria; aberrant right subclavian artery; dysphagia lusoria; aortic arch variation; additional arterial branch; cadaveric dissection

САЖЕТАК

Увод Варијације у обрасцу гранања лука аорте представљају значајне анатомске разлике које могу имати важне импликације за хируршке захвате на глави, врату и горњим екстремитетима, као и за ендоваскуларне процедуре и радиолошке евалуације. Циљ овог рада био је да се прикаже ретроезофагеална аберантна десна поткључна артерија удружена са додатном артеријском граном, уочена током рутинске кадаверичне дисекције.

Приказ случаја Током торакалне дисекције 69-годишњег мушког кадавера коришћеног у наставне сврхе на Катедри за анатомију Медицинског факултета Универзитета Кафкас испитан је образац гранања лука аорте. Утврђено је одсуство брахиоцефаличног стабла. Лук аорте давао је редом десну заједничку каротидну артерију, леву заједничку каротидну артерију и леву поткључну артерију. Десна поткључна артерија полазила је са дисталног дела лука аорте и пролазила иза једњака пре него што је наставила ток ка десној страни и горњем екстремитету. Поред тога, идентификована је додатна артеријска грана која је полазила из десне поткључне артерије, пролазила изнад предњег скаленског мишића и дистално се поново уливала у десну поткључну артерију.

Закључак Аберантна десна поткључна артерија представља ретку, али клинички значајну васкуларну варијацију. У случајевима са ретроезофагеалним током може изазвати различите клиничке манифестације, нарочито дисфагију. Измењени анатомски односи могу представљати дијагностички и хируршки изазов током торакалних операција, васкуларних интервенција и радиолошких процедура. Присуство додатне артеријске гране уз аберантну десну поткључну артерију у приказаном случају указује на разноврсност васкуларних варијација горњег екстремитета. Познавање оваквих варијација важно је за превенцију могућих компликација током дијагностичких и интервенционих процедура.

Кључне речи: arteria lusoria; аберантна десна поткључна артерија; dysphagia lusoria; варијација лука аорте; додатна артеријска грана; кадаверична дисекција

INTRODUCTION

Aberrant right subclavian artery, also known as *arteria lusoria*, is one of the most common congenital variations of the aortic arch branching pattern. The reported prevalence of aberrant right subclavian artery ranges from 0.5% to 2.5% of the population. Within its normal distribution and course, the right subclavian artery originates from the brachiocephalic trunk; however, in this variant form, it originates from the distal portion of the aortic arch and runs through the posterior mediastinum to reach the upper limb [1–5]. Developmentally, this condition arises as a result of the regression of the right fourth aortic arch and the proximal portion of the right dorsal aorta [6].

In most cases, the aberrant subclavian artery runs retroesophageal within the mediastinum. Although the aberrant right subclavian artery most commonly follows a retroesophageal course, alternative courses have also been described, including passage between the trachea and esophagus [7]. As a result of this anatomical relationship, the pressure it exerts on the esophagus may lead to a condition known as ‘*dysphagia lusoria*’, as well as clinical symptoms such as chronic cough and dyspnea [4, 8, 9, 10]. The identification of this variation is important in terms of thoracic vascular surgery, endovascular procedures and the accurate interpretation of radiological images. Furthermore, the fact that the aberrant right subclavian artery is often associated with additional anatomical variations – such as different variations of the aortic arch, Kommerell’s diverticulum, and a non-recurrent recurrent laryngeal nerve – highlights the need for further assessment during preoperative planning [9]. By highlighting such variations in cadaver-based studies, significant contributions are made to the literature on clinical and surgical anatomy [10]. This study presents a rare cadaveric case involving an aberrant right subclavian artery with a retroesophageal course and an associated additional arterial branch variation.

CASE REPORT

A variation was identified during the thoracic dissection of a 69-year-old male cadaver used for teaching purposes at the Department of Anatomy, Faculty of Medicine, Kafkas University. Upon opening the thoracic cavity, the mediastinal structures and the branches of the aortic arch were observed. The examination revealed that the right common carotid artery, the left common carotid artery and the left subclavian artery arise from the aortic arch, in that order. It was found that the right subclavian artery originates from the aortic arch as the fourth branch (Figure 1). It was observed that the aberrant right subclavian artery passed through the posterior mediastinum, coursing directly posterior to the esophagus before continuing toward the right thoracic aperture (Figure 2). It was subsequently determined that it reached the right thoracic aperture and continued its normal anatomical course. An additional vascular branch, appearing as a ring-like structure, was identified in the immediate vicinity of the anterior scalene muscle; it originated from the right subclavian artery and also opened into the right subclavian artery (Figure 3). It was observed that the artery then continued its normal anatomical course in the upper extremity. Morphometric measurements were performed using a digital caliper. The external diameter of the aberrant right subclavian artery was measured approximately 5 mm distal to its origin from the aortic arch, and its length was measured along the vascular course from its aortic origin to the level of the right first rib. The external diameter of the additional arterial branch was measured approximately 3–5 mm distal to its origin, and its length was measured along the vessel from its origin from the aberrant right subclavian artery to the point where it rejoined the same artery. Each measurement was repeated three times, and the mean value was recorded. The morphometric measurements are presented in Table 1.

DISCUSSION

The most significant finding of this study is the presence of an aberrant right subclavian artery with a retroesophageal course, originating from the terminal branch of the aortic arch. Furthermore, the presence of an additional arterial structure with a loop-like appearance which branches off from the right subclavian artery and rejoins the same vessel distally is a notable finding that distinguishes this case from the classic cases of *arteria lusoria* described in the literature. Although the right subclavian artery is a well-defined and frequently reported vascular variation in the literature, reports of additional arterial structures associated with this artery are quite limited. For this reason, this case report does not represent a typical example of an *arteria lusoria*, but is unique due to the associated vascular structure.

A review of the literature shows that, whilst Bizhga et al. reported a case in which an aberrant right subclavian artery was observed in conjunction with a bicarotic trunk, the review by Natsis et al. identified Kommerell's diverticulum and the non-recurrent laryngeal nerve as the most common associated variations [3, 11]. In the cadaveric case presented by Panteleeva et al. it was found that the diameter of the aberrant right subclavian artery was significantly narrower than normal and exhibited an unusual morphology [12]. Similarly, Annetta et al. noted that an aberrant right subclavian artery detected during the prenatal period may be associated with congenital cardiovascular anomalies and chromosomal abnormalities [5]. These data indicate that the aberrant right subclavian artery is often associated with various vascular or developmental anomalies. In a large series of 1,266 patients, Vučurević et al. demonstrated considerable variability in the branching patterns of the aortic arch, including configurations involving an aberrant right subclavian artery [13]. Previous reports and studies describing aberrant right subclavian artery and associated anatomical variations are summarized in Table 2.

In the case presented here, the aberrant right subclavian artery originates as the terminal branch of the aortic arch and runs posterior to the esophagus into the mediastinum, which is typical of the morphology of a lusoria artery. Indeed, in a systematic review conducted by Nedelcu et al., it was reported that in 49 out of 51 cases, the right subclavian artery had a retroesophageal course, whilst in the remaining 2 cases, it had a pretracheal course [6, 14]. In our case, too, this structure passes posterior to the esophagus. In this respect, the case reflects the typical pattern of arteria lusoria described in the literature. However, the key feature distinguishing our case from others in the literature is the presence of an additional vascular structure originating from the right subclavian artery, passing through the superior aspect of the anterior scalene muscle, and opening back into the right subclavian artery. The studies reviewed found that the aberrant subclavian artery is frequently accompanied by variations such as the truncus bicaroticus, Kommerell's diverticulum, the non-recurrent laryngeal nerve and the right vertebral artery [3, 11, 14]. It is thought that the accessory arterial branch accompanying the aberrant right subclavian artery in the present case may represent a vascular variation pattern that has rarely been reported in the literature.

Embryologically, the normal right subclavian artery develops from the right fourth aortic arch, a segment of the right dorsal aorta, and the right seventh intersegmental artery. During normal development, the distal part of the right dorsal aorta regresses, while the right fourth aortic arch remains connected to the seventh intersegmental artery to form the right subclavian artery. An aberrant right subclavian artery develops when the right fourth aortic arch and the proximal segment of the right dorsal aorta regress abnormally, while the distal right dorsal aorta persists in continuity with the right seventh intersegmental artery. As a result, the artery arises distally from the aortic arch and commonly follows a retroesophageal course [6,14]. It is thought that the additional arterial structure observed in our case may have developed as a result of the persistence of vascular segments that would normally regress during embryonic development.

However, the current anatomical findings are insufficient to establish the exact embryological origin of this structure (Figure 4).

From a clinical perspective, the retroesophageal course of the aberrant subclavian artery is of particular importance, especially in relation to the development of dysphagia lusoria. It has been reported in various cases that, due to the artery's retroesophageal course, it may compress the esophagus and cause dysphagia [8-10]. Furthermore, in terms of preventing potential complications, prior knowledge of this artery will be advantageous in both thoracic surgery and radiological assessments. In particular, the additional vascular structure identified in our case may increase the risk of unexpected vascular injury during surgery in the supraclavicular region and at the thoracic outlet.

Ethics: The cadaver used in this study is part of the educational collection of the Department of Anatomy at the Faculty of Medicine, Kafkas University, and has been assessed in accordance with institutional regulations and national legislation regarding its use for educational and scientific research purposes. As this study constitutes a cadaver-based case report, approval from an ethics committee was not required. Following consultation with our institution, institutional approval was obtained for the use of the cadaveric educational material for scientific research and international publication purposes (approval no. E-85063915-929.01-91106,).

Conflict of Interest: None declared.

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Table 1. Morphometric measurements of the aberrant right subclavian artery (ARSA) and associated additional arterial branch

Parameter	Measurement method	Measurement (mm)
ARSA diameter at origin	External diameter measured approximately 5 mm distal to the origin of the aberrant right subclavian artery from the aortic arch	24.8 mm
ARSA length	Distance measured along the vascular course from the origin of the ARSA at the aortic arch to the level of the right first rib/thoracic outlet	105.6 mm
Additional arterial branch diameter	External diameter measured approximately 3–5 mm distal to the origin of the additional arterial branch from the ARSA	3.9 mm
Additional arterial branch length	Distance measured along the vascular course from the point where the additional arterial branch originates from the ARSA to the point where it rejoins the ARSA	71.7 mm

Table 2. Summary of previous studies describing aberrant right subclavian artery (ARSA) and associated variations

Author, year	Study type / sample	Main ARSA finding	Associated variation / notable feature
Natsis et al., 2011 [11]	Two case reports and literature review	ARSA arising directly from the aortic arch	Associated bicarotid trunk ; discussion of clinical implications
Vučurević et al., 2013 [13]	Angiographic/multislice computed tomography study of 1266 cases	Aortic origin of both common carotid and subclavian arteries; retroesophageal right subclavian artery in type IV pattern	Type IV variation found in 0.55% ; extensive classification of aortic arch branch variations
Annetta et al., 2022 [6]	Review of prenatal ultrasound studies	ARSA arising directly from the aortic arch and crossing posterior to the trachea toward the right upper limb	Association with chromosomal abnormalities evaluated; isolated ARSA generally not strongly associated with pathogenic genetic abnormalities
Bizhga et al., 2024 [3]	Case report and literature review	Retroesophageal ARSA causing dysphagia lusoria in an infant	Associated bicarotid trunk ; symptomatic dysphagia and stridor, treated surgically
Nedelcu et al., 2024 [14]	Systematic review; 47 articles, 51 ARSA cases	Retroesophageal course in 49/51 cases	Kommerell diverticulum in 15/51, bicarotid trunk in 7/51, aberrant right vertebral artery origin in 7/51
Panteleeva et al., 2025 [12]	Cadaveric case report + systematic review of cadaveric studies	ARSA identified during dissection of an 83-year-old female cadaver	Unusually narrow ARSA lumen compared with previously reported cases
Present case	Cadaveric case report	Retroesophageal ARSA arising from the distal aortic arch	Additional arterial branch arising from and rejoining the ARSA



Figure 1. The branching pattern of the aortic arch; RCCA – right common carotid artery; LCCA – left common carotid artery; ARSA – aberrant right subclavian artery; LSA – left subclavian artery



Figure 2. The retroesophageal course of the aberrant right subclavian artery (ARSA) as it passes posterior to the esophagus (Es); Tr – trachea

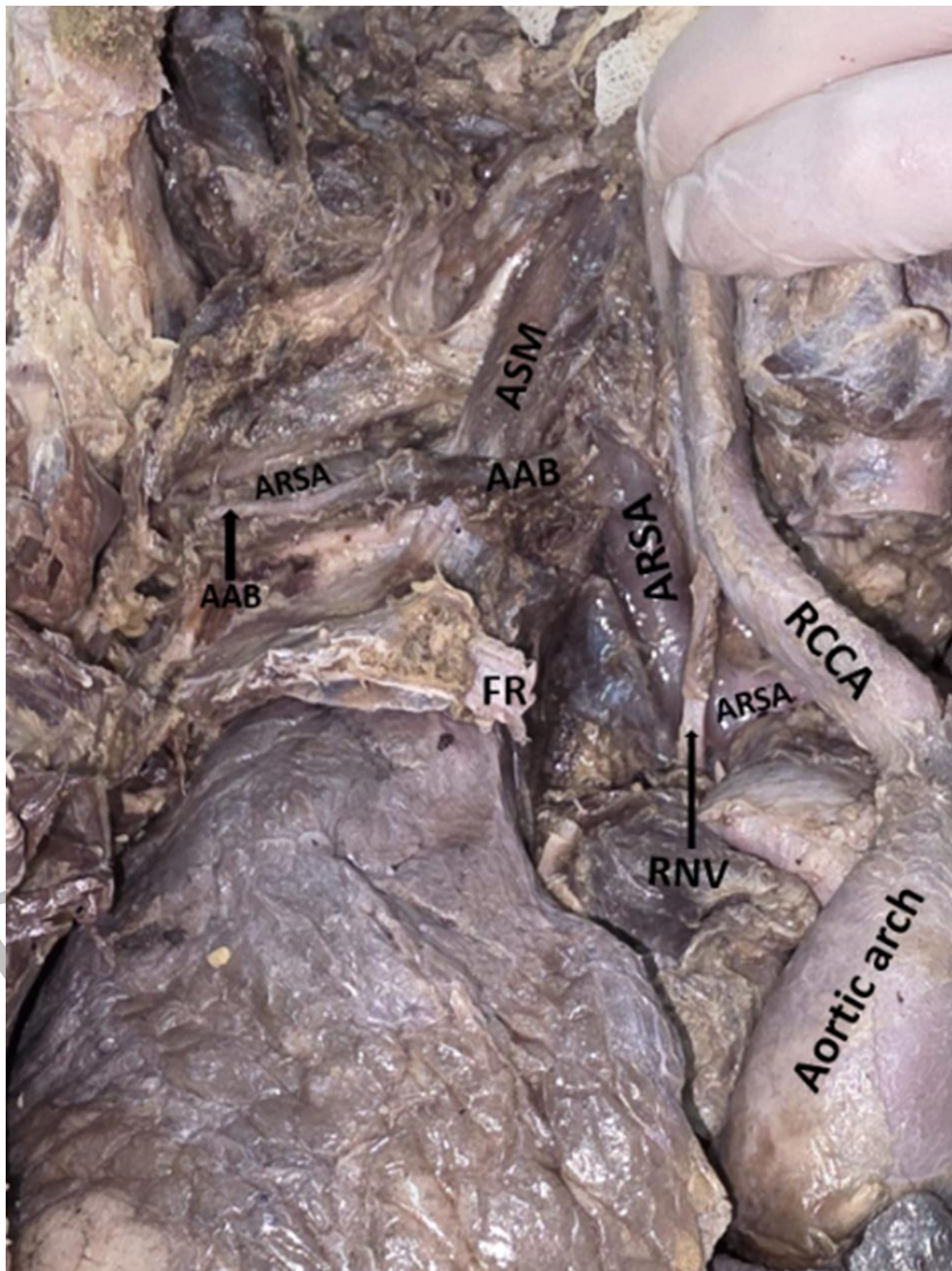


Figure 3. Aberrant right subclavian artery and associated additional arterial branch observed at the level of the right thoracic aperture; the additional arterial branch (AAB) arises from the aberrant right subclavian artery (ARSA), passes superior to the anterior scalene muscle (ASM), and rejoins the ARSA distally; RVN – right vagus nerve; RCCA – right common carotid artery; FR – first rib

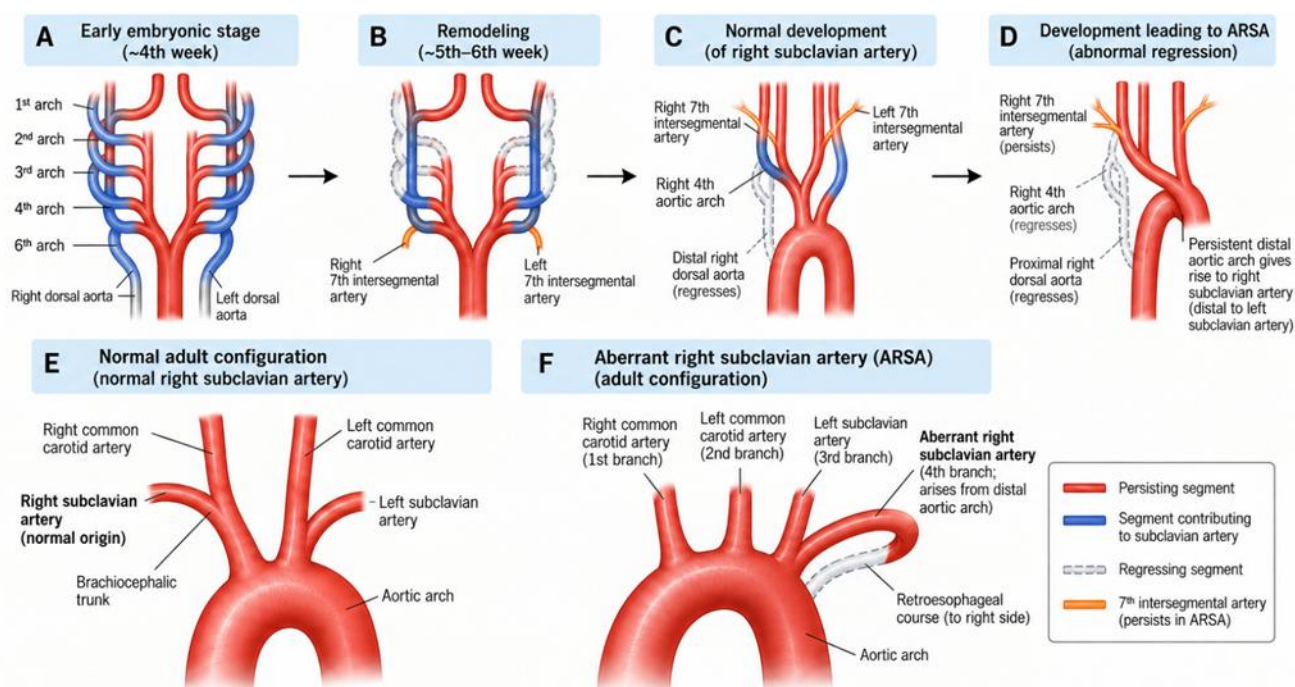


Figure 4. Embryologic development of the aortic arch and formation of an aberrant right subclavian artery arising from the distal aortic arch; A – early embryonic stage showing the paired aortic arches and dorsal aortae; B – remodeling of the aortic arches with regression of selected segments; C – normal development of the right subclavian artery from the right fourth aortic arch, distal right dorsal aorta, and right seventh intersegmental artery; D – development leading to an aberrant right subclavian artery due to regression of the right fourth aortic arch and proximal right dorsal aorta, with persistence of the distal right dorsal aorta; E – normal adult configuration; F – aberrant right subclavian artery arising directly from the distal aortic arch and following a retroesophageal course