ISSN 2563-7142

CASE REPORT

Overall Prevalence and Clinical Significance of a Retroesophageal Right Subclavian Artery with a Non-Recurrent Right Laryngeal Nerve in an 83-year-old and a 93-year-old White Male Donor

Ryan Hotchkiss[1], Aaron Kilgore[1], Elizabeth Maynes[2], Maria Ximena Leighton[2], Gary Wind[2], Kerrie Lashley[3], Teresa Buescher[4], Jordan Dimitrakoff[2], Guinevere Granite[2*]

Hotchkiss R, Kilgore A, Maynes E et al. Overall Prevalence and Clinical Significance of a Retroesophageal Right Subclavian Artery with a Non-Recurrent Right Laryngeal Nerve in an 83-year-old and a 93-year-old White Male Donor. Int J Cadaver Stud Ant Var. 2023;4(2):75-80.

Abstract

Head and neck anatomic variations are common and generally go undetected but may be clinically significant or have important surgical consequences. Knowledge of various abnormalities is important for clinical decision-making and the avoidance of iatrogenic complications. Anomalies of the aortic arch and its various branches are relatively common. However, rare variations with profound clinical sequelae can occur. During cadaveric dissection, we identified an 83-year-old and a 93-year-old White male donors who both had a right retroesophageal subclavian artery with an associated non-recurrent right laryngeal nerve. Lack of knowledge of this anatomic variation can directly result in severe consequences for patients and lead to major morbidity. Understanding this variation and recognizing it will be important for anatomists, radiologists, and surgeons.

Key Words: *Right retroesophageal subclavian artery; Non-recurrent right laryngeal nerve; Aberrant right subclavian artery; Head and neck anatomical variations*

[1]F. Edward Hebert School of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD 20814, USA

[2]Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, MD 20814, USA

[3]Department of Anatomy and Cell Biology, George Washington School of Medicine & Health Sciences, Washington, DC, USA

[4]The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc., Bethesda, MD 20814, USA

[*]Corresponding author: Guinevere Granite, Director of Human Anatomy, Department of Surgery, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, A3020C, Bethesda, MD, USA, Tel: 301-295-1500; E-mail: guinevere.granite@usuhs.edu

Received: July 27, 2023, Accepted: September 01, 2023, Published: September 12, 2023

ISSN 2563-7142

Introduction

The aortic arch (AA) normally gives rise to three branches: the right brachiocephalic trunk (RBT), the left common carotid artery (LCCA), and the left subclavian artery (LSA) (Figure 1a). Variations of the AA and these branches are relatively common, with 1 to 3% of human fetuses critically examined exhibiting an abnormality [1]. The aberrant right subclavian artery (ARSA) variation, also known as arteria lusoria (Latin derivative for 'freak of nature'), arises as the fourth branch of the AA distal to the LSA and is the most common AA variation. ARSA crosses upward and to the right in the posterior mediastinum behind the esophagus approximately 80% of the time [2], in which case, the variation is reclassified as right retroesophageal subclavian arteries (RRSA) (Figure 1b). The RSA can also course between the trachea and esophagus (Figure 1c). In these RRSA cases, the RBT is absent, and the four AA branches are as follows proximal to distal: the right common carotid artery (RCCA), the LCCA, the LSA, and the RRSA. Most of these cases are asymptomatic and found incidentally. Roughly 10% of cases, however, report dysphagia symptoms, termed dysphagia lusoria [3]. The RRSA variation, even in asymptomatic patients, becomes clinically important in a variety of settings, including thoracic and neurosurgeries, cardiac catheterization procedures, and diagnostic angiography [4-9].

During routine anatomical dissection of 260 human donors during the 2018-2023 medical and graduate nursing school anatomy courses at the Uniformed Services University of the Health Sciences (USUHS), three cases of a RRSA were identified. Granite et al. (2018) published on a five branched aortic arch exhibiting a retroesophageal right subclavian artery and an accessory left vertebral artery found with a 76-year-old White male donor [10]. Here we describe two additional cases discovered since the time of that publication.

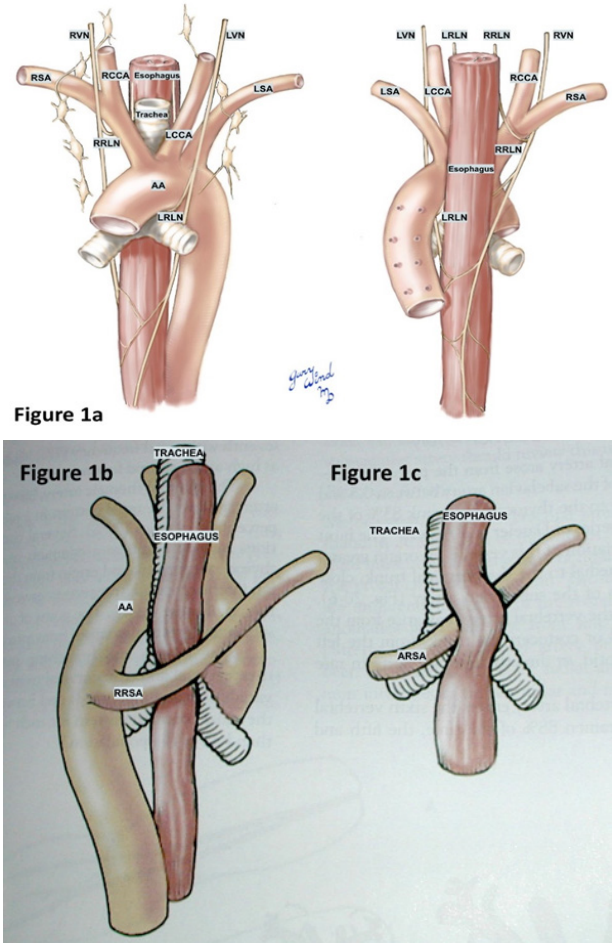


Figure 1) *Schematics demonstrating (a) normal aortic arch anatomy (anterior and posterior views) and (b & c) two variants of the Arteria lusoria (right retroesophageal subclavian artery) branching from the distal aortic arch and coursing posteriorly to the right side. 1b depicts RRSA coursing posterior to the esophagus representing potential for dysphagia secondary to esophageal compression. 1c depicts RRSA coursing in-between the trachea and esophagus representing potential for tracheal compression.*

AA: Aortic arch; LCCA: Left common carotid artery; LSA: Left subclavian artery; RCCA: Right common carotid artery; RSA: Right subclavian artery; RRSA: Right Retroesophageal Subclavian Artery; ARSA: Aberrant Right Subclavian Artery; RVN: Right vagus nerve; RRLN: Right recurrent laryngeal nerve; LVN: Left vagus nerve.

Case Descriptions

The first donor was an 83-year-old White male donor with a cause of death noted to be from coronary artery disease. The LSA first branched into the left vertebral artery followed by the left

thyrocervical trunk (LTCT). The LTCT then further divided into the left inferior thyroid artery, common trunk of the left ascending cervical artery (LACA), the left transverse cervical artery (LTCA), and the left suprascapular artery (LSSA). Continuing along the LSA distal to the TCT, the left internal thoracic artery (LITA) branched off, succeeded by the left costocervical trunk (LCCT). The LCCT further subdivided into the left supreme intercostal artery (LSIA) and left deep cervical artery (LDCA). Notably, the donor had a RRSA, which branched off the ascending aorta and traveled posterior to esophagus. The RRSA had a non-recurrent right laryngeal nerve (RLN) and a small cyst located on it just before the artery coursed to the right and began its subclavian branching approximately one inch distal to the right vertebral artery (RVA). The RRSA first branched into the RVA and then the right thyrocervical trunk (RTCT). The RTCT branched into the right inferior thyroid artery (RInfTA), the common trunk of the right ascending cervical artery (RACA), the right transverse cervical artery (RTCA), and two branches of the right suprascapular artery (RSSA). The right internal thoracic artery (RITA) then arose from the right subclavian artery (RSA) followed by the right costocervical trunk (RCCT), which divided into the right supreme intercostal artery (RSIA) and the right deep cervical artery (RDCA) (Figure 2).

The second donor was found to have the same arterial anatomy including the subclavian branching anomaly. This donor was a 93-year-old White male with COPD as the determined cause of death. This individual had a RRSA and an associated non-recurrent RLN (Figures 3a and 3b).

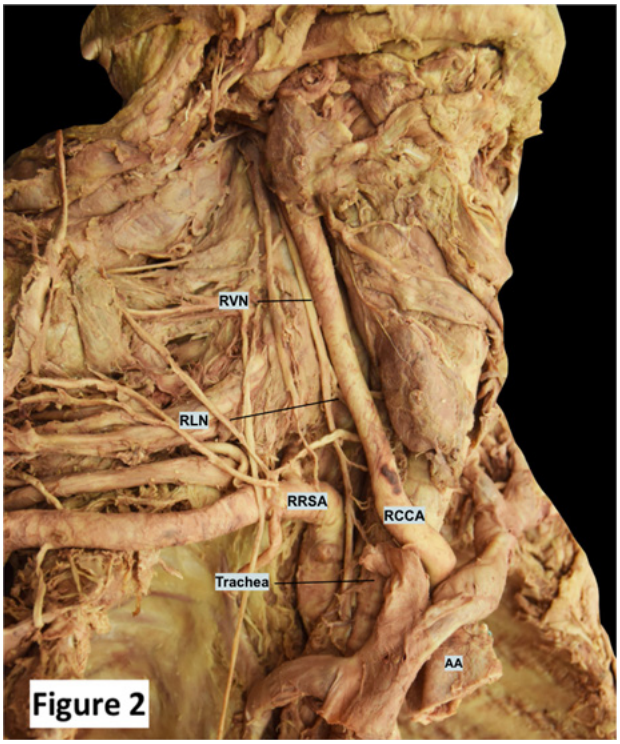
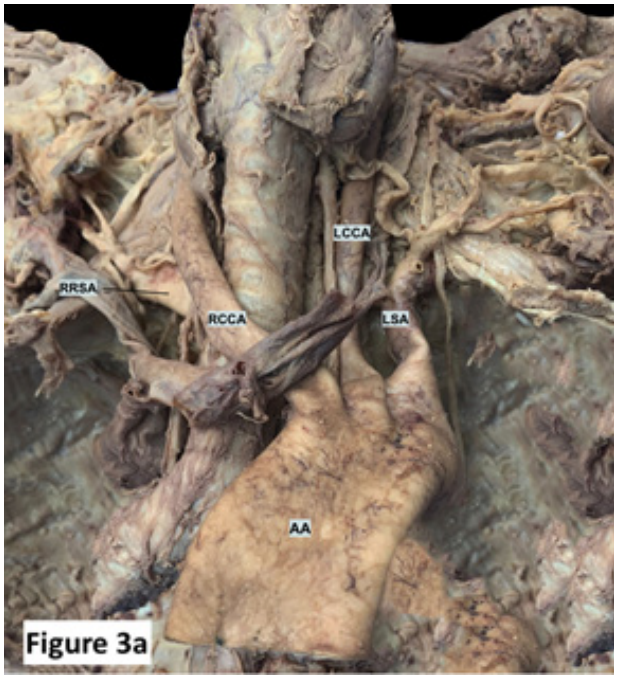


Figure 2) *This image depicts the course of the RRSA in an 83-year-old White male donor. It branches off the distal AA (not shown) before wrapping around both the trachea and esophagus posteriorly and continuing to the right laterally. The NRLN is also shown as an early branch of the RVN at the level of the mid-thyroid to directly innervate the larynx.*

AA: Aortic arch; RCCA: Right common carotid artery; RLN: Right laryngeal nerve (non-recurrent); RRSA: Right retroesophageal subclavian artery; RVN: Right vagus nerve.



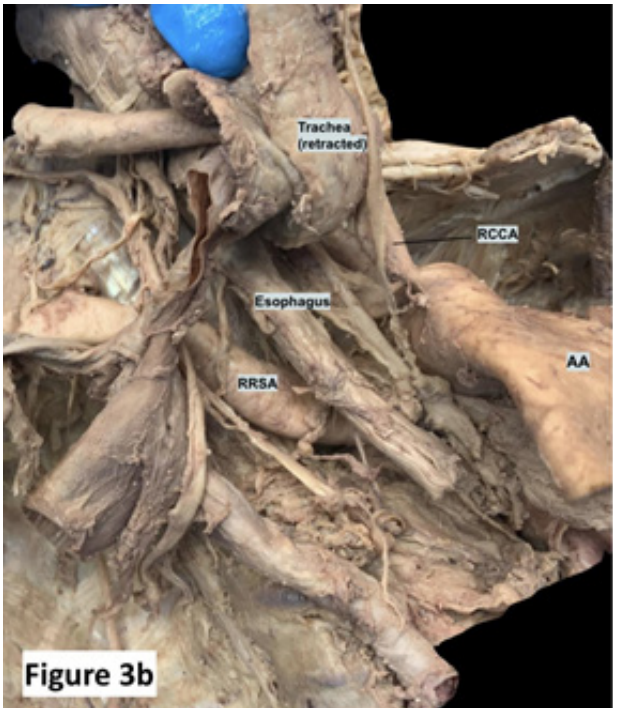


Figure 3) *Images depicting (a) an additional example of an RRSA variant discovered in a 93-year-old White male donor with a cause of death of COPD (anterior view) and (b) a retracted trachea to better visualize the right retroesophageal subclavian artery coursing behind the esophagus.*

AA: Aortic arch; LCCA: Left common carotid artery; LSA: Left subclavian artery; RCCA: Right common carotid artery; RRSA: Right retroesophageal subclavian artery.

Discussion

An ARSA is a rare congenital vascular variation. During the fourth week of embryological development, the six pairs of aortic arches begin to form. The left fourth aortic arch persists to give rise to the medial portion of the arch of the aorta, while the right fourth aortic arch regresses to contribute to the proximal RSA. Occasionally, however, this right fourth aortic arch fails to undergo its normal regression and leads to the development of ARSA variants, such as the RRSA [10,11]. This variant is typically asymptomatic or with symptoms appearing later in life [8,10]. It is the most common vascular ring anomaly and can cause symptoms of dyspnea, dysphagia, cough, stridor, thoracic pain, and pneumonia, usually secondary to compression of the esophagus or trachea. The adult population, being more resistant to tracheal compression, more commonly presents with dysphagia. Whereas the pediatric population can present in respiratory distress [1,8,9,13-15]. RRSA, a specific subset of ARSA, has been estimated to occur in 1-3% of the overall population [1]. During examination of 260 cadavers at USUHS a total of three RRSA have been identified, representing a 1.15% prevalence [10].

In order to reach the right upper extremity, the ARSA must cross from left to right in one of three possible ways: posterior to the esophagus (80% of cases), between the esophagus and the trachea (10% to 15%), or anterior to the trachea (4.2-5%) [9,14,16]. Consequently, the AA has four branches: the RCCA, LCCA, LSA, and the ARSA. ARSA has been reported more frequently in females. The prevalence of ARSA also rises substantially in individuals with chromosomal defects, including Down syndrome and DiGeorge syndrome [1,8].

Also demonstrated in this specific case is the presence of a non-recurrent RLN. The non-recurrent RLN variant is associated with ARSA, which has been reported to be present in 89.3% of cases [17]. The clinical relevance of this anatomic anomaly pertains to surgery, particularly of the thyroid. RLN injury is a serious complication that can arise during thyroid surgery, damage to this structure can result in vocal cord paralysis causing profound morbidity in affected patients. The anomalous position of the non-recurrent RLN makes it more vulnerable to iatrogenic injury in thyroid surgeries if not identified properly [18]. Up to a six-fold increase in intraoperative nerve injury can occur given the presence of an undetected non-recurrent RLN [19].

Conclusion

Aortic arch variations are numerous in kind, prevalent among the population, and have the

potential to be clinically significant. The ARSA, namely the RRSA variation, is highlighted in this report. Only a fraction of these anomalies contributes to symptoms in patients, and therefore, the majority are discovered incidentally during diagnostic imaging and procedures, such as angiographies and head and neck surgery. Examples include transradial approach for coronary angiography and thyroidectomy because of the high association between ARSA and non-recurrent RLN. As medicine relies more on diagnostic imaging and as procedural ingenuity progresses, ARSA will be encountered more frequently. Thus, understanding this variation and recognizing it will be important for anatomists, radiologists, and surgeons.

Acknowledgment

We would like to thank the families of our donors for their beneficent contribution. Without their generosity, this article would not have been possible.

Disclaimer

The opinions or assertions contained herein are the private ones of the author/speaker and are not to be construed as official or reflecting the views of the Department of Defense, the Uniformed Services University of the Health Sciences, or any other agency of the U.S. Government.

The contents of this presentation are the sole responsibility of the author(s) and do not necessarily reflect the views, opinions, or policies of Uniformed Services University of the Health Sciences (USUHS), The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc., the Department of Defense (DoD) or the Departments of the Army, Navy, or Air Force. Mention of trade names, commercial products, or organizations does not imply endorsement by the U.S. Government.

References

1. Chaoui R, Rake A, Heling KS. Aortic arch with four vessels: aberrant right subclavian artery. Ultrasound Obstet Gynecol. 2008;31:115-7.
2. Maiti TK, Konar SK, Bir S, et al. Anomalous origin of the right vertebral artery: incidence and significance. World Neurosurg. 2016;89:601-10.
3. Ka-Tak W, Lam WWM, Yu SCH. MDCT of an aberrant right subclavian artery and of bilateral vertebral arteries with anomalous origins. Am J Roentgenol. 2007;188:W274-5.
4. Kim MS. Duplicated vertebral artery: literature review and clinical significance. J Korean Neurosurg Soc. 2018;61:28-34.
5. Rameshbabu CS, Gupta OMP, Gupta KK, et al. Bilateral asymmetrical duplicated origin of vertebral arteries: Multidetector row CT angiographic study. Indian J Radiol Imaging. 2014;24:61-5.
6. Shi S. Arterial vascular variation of the head and neck and its clinical significance. J Neurol Neurophysiol. 2017.
7. Cheng M, Xiaodong X, Wang C, et al. Two anatomic variations of the vertebral artery in four patients. Ann Vasc Surg. 2009;23:689.e1-5.
8. Kanaskar N, Vatsalaswamy P, Sonje P, et al. Retroesophageal right subclavian artery. Adv Anat. 2014;2014:1-3.
9. Lale P, Toprak U, Yagiz G, et al. Variations in the branching pattern of the aortic arch detected with computerized tomography angiography. Adv Radiol. 2014;2014:1-6.
10. Granite G, Meshida K, Jones S, et al. Rare case of a five-branched aortic arch exhibiting a retroesophageal right subclavian artery and an accessory left vertebral artery. Int J Anat Var. 2018;33:117-22.

11. Rosen RD, Bordoni B. Embryology, Aortic Arch. StatPearls. 2023.

12. Atay Y, Engin C, Posacioglu H, et al. Surgical approaches to the aberrant right subclavian artery. Tex Heart Inst J. 2006;33:477-81.

13. Darwazah AK, Eida M, Khalil A, et al. Non-aneurysmal aberrant right subclavian artery causing dysphagia in a young girl: challenges encountered using supraclavicular approach. J Cardiothorac Surg. 2015;10:92.

14. Epstein DA, DeBord JR. Abnormalities associated with aberrant right subclavian arteries: a case report. Vasc Endovascular Surg. 2002;36:297-303.

15. Kieffer E, Bahnini A, Koskas F. Aberrant subclavian artery: surgical treatment in thirty-three adult patients. J Vasc Surg. 1994;19:100-11.

16. Naqvi SEH, Beg MH, Thingam SKS, et al. Aberrant right subclavian artery presenting as tracheoesophageal fistula in a 50-year-old lady: case report of a rare presentation of a common arch anomaly. Ann Pediatr Cardiol. 2017;10:190-3.

17. Henry BM, Sanna S, Graves MJ, et al. The non-recurrent laryngeal nerve: a meta-analysis and clinical considerations. PeerJ. 2017;5:e3012.

18. Lee YK, Yang W, Ghedia R, et al. Non-recurrent laryngeal nerve and aberrant subclavian artery in thyroidectomy. BMJ Case Rep. 2022;15:e251374.

19. Toniato A, Mazzarotto R, Piotto A, et al. Identification of the nonrecurrent laryngeal nerve during thyroid surgery: 20-year experience. World J Surg. 2004;28:659-61.