American Research Journal of Anatomy

Volume 1, Issue 1, 1-4 Pages
Research Article | Open Access

An Aberrant Right Subclavian Artery: A Cadaveric Case Study

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ABSTRACT

This report describes the incidental discovery of a rare cadaveric anomaly—an aberrant right subclavian artery (ARSA)—encountered during a routine dissection in a first-year medical anatomy course. The subject, an 88-year-old female, had Clostridium difficile colitis as the primary cause of death, with pneumonia listed as a contributing factor. The ARSA, originated as the final branch of the aortic arch, distal to the left subclavian artery, and coursed posteriorly to the esophagus and trachea toward right upper extremity. Anatomically, this variation was characterized by the absence of the brachiocephalic trunk, with four separate arteries arising directly from the aortic arch. While the ARSA itself may not have been directly responsible for the patient's cause of death, its potential clinical relevance warrants consideration. The aberrant artery is often associated with complications, such as dysphagia, recurrent respiratory infections, and challenges in vascular interventions. Additionally, its propensity for dilatation—particularly at the junction with the aortic arch—can lead to compression of nearby structures, contributing to symptoms such as dysphagia lusoria and impaired clearance of bronchial secretions. This case underscores the importance of thorough anatomical examination and an enhanced awareness of vascular variations, which are crucial for both clinical management and educational purposes. The discovery of such an anatomical anomaly emphasizes the significance of cadaveric studies in advancing medical education and further highlights the need for comprehensive clinical understanding of rare vascular variants.

Objective: *This report describes a rare cadaveric finding of an aberrant right subclavian artery (ARSA) discovered during a routine dissection in a first-year medical anatomy course.*

Case Description: *During a cadaver dissection session, an 88-year-old female cadaver was found to have an ARSA. The anomaly was characterized by the absence of the brachiocephalic trunk and the presence of four separate arteries originating directly from the aortic arch. The ARSA originated as the last branch of the aortic arch, distal to the left subclavian artery, and coursed posterior to the esophagus and trachea before reaching the right upper extremity.*

Conclusion: *The discovery of an ARSA highlights the importance of thorough anatomical examination and awareness of potential variations. This anatomical variant has significant clinical implications, including potential dysphagia, surgical considerations, and association with other congenital anomalies.*

INTRODUCTION

Aberrant right subclavian artery (ARSA) is the most common congenital anomaly of the aortic arch, occurring in approximately 0.5-2.5% of the population (Polguj et al., 2014). This anatomical variation results from abnormal regression of the right fourth aortic arch during embryonic development. The students' discovery represents a case of aberrant right subclavian artery (ARSA). In 80% of ARSA cases, the vessel travels posterior to the esophagus, in the other 20% of cases, the vessel will course between the trachea and esophagus.. Recent studies have highlighted the clinical significance of ARSA, including symptomatic and surgical considerations. For instance, 30-40% of adults with ARSA will experience Dysphagia lusoria, a swallowing difficulty caused by esophageal compression (Levitt & Richter, 2007). Knowledge of this variation is crucial for thoracic surgeons and interventional radiologists to avoid complications during procedures involving the aortic arch or its branches (Wang et al., 2020). Furthermore, a significant association between ARSA and Down syndrome in fetuses has been revealed, underscoring its relevance in prenatal diagnostics (Scala et al., 2015). Whole-body CT scans have observed a higher incidence of aneurysmal dilatation at the ARSA origin, with the potential to become symptomatic or pose risk for dissection, highlighting the importance of long-term monitoring in affected individuals (Krupiński et al., 2019).

CASE PRESENTATIONS

An 88-year-old female cadaver (weight 120 lbs, BMI 18.2, 68 inches) was dissected as part of a first-year medical anatomy course at the University of California, Riverside School of Medicine. The primary cause of death was Clostridium

difficile colitis, with pneumonia and Alzheimer's disease as contributing factors.

The abnormality was discovered during a dissection of the superior and posterior mediastinum. Fat and connective tissue posterior to the manubrium were removed, allowing visualization of the left and right brachiocephalic veins. The trachea and superior vena cava served as landmarks to locate and isolate the right vagus nerve. Dissection of the left vagus nerve proceeded as it crossed the anterior aspect of the aortic arch, and the left recurrent laryngeal nerve was traced as it looped under the aortic arch and ligamentum arteriosum. The pericardium was then detached from the posterior thoracic wall and reflected inferiorly to expose the posterior mediastinum(1 - Image).

Upon revealing the great vessels, an absent brachiocephalic trunk was noted, with four arteries originating directly from the aortic arch in sequence from right to left—right common carotid artery, left common carotid artery, left subclavian artery, and an aberrant right subclavian artery. The aberrant right subclavian artery followed a course posterior to the esophagus and trachea before extending to the right upper extremity. No additional vascular anomalies were observed. The vessel was found to have a roughly 55mm circumference (17.5mm diameter), at the base.

The cadaver was embalmed by, and obtained from the body donation program of University of California Los Angeles.

DISCUSSION

The presence of ARSA can have several clinical implications. Dilatation can occur in 20 - 60% of individuals with an aberrant subclavian artery, and most commonly occurs at the junction of the aberrant artery and the aortic arch. This is known as a kommerell's diverticulum (Tanaka et al., 2015). Given the position of this vessel, a Kommerell's diverticulum can cause esophageal compression and tracheal compression, which can potentially cause a broad spectrum of clinical manifestations including dysphagia, cough, retrosternal pain, recurrent lower respiratory infections and weight loss (Levitt & Richter, 2007).

When presenting with symptoms, surgery is generally indicated to repair aberrant subclavian arteries with associated kommerell diverticulum, such surgeries are considered to have a low risk of complications and when occurring, these complications are associated with low mortality (Loschi et al., 2023; Tallarita et al., 2023). When an ARSA is not associated with symptoms (as is often the case when discovered incidentally on imaging), data on the correct course of action is limited and heterogeneous. The European Society for Vascular Surgery recommends intervention when any subclavian artery measures more than 30mm in diameter and for any kommerell's diverticulum greater than 55 mm in diameter (Grabenwöger et al., 2012). The American Heart association and the Society for Vascular Surgery recommend intervention when any subclavian artery measures more than 30mm in diameter and for any kommerell's diverticulum greater than 50 mm in diameter (Upchurch et al., 2021). For asymptomatic patients with nonaneurysmal ARSA, conservative management with regular surveillance via imaging and follow up is often recommended by all the professional societies listed above. In a recent study, 30 patients with an ARSA followed with imaging for over a decade found relatively low rates of complication and need for intervention among this subgroup (Dong et al., 2022). Others suggest that intervention for a Komerrell's diverticula at 40mm is preferable, citing a relatively low risk of complications and worse outcomes with symptomatic and dilated vessels (Bath et al., 2023).

The rarity of ARSA has limited the availability of large-scale studies, and management guidelines are still evolving. Currently, both endovascular and hybrid approaches are utilized when a repair is indicated, with provider familiarity and patient specifics dictating the approach (Dong et al., 2022). Tanaka et al. reported successful outcomes using thoracic endovascular aortic repair (TEVAR) for Kommerell's diverticulum associated with ARSA (Tanaka et al., 2015). Hybrid procedures include right carotid-subclavian bypass or transposition combined with thoracic endovascular aortic repair (Dong et al., 2022).

In the case of this patient, the cause of death was C. Difficle colitis, with pneumonia listed as a secondary cause. The ARSA in this case does courses behind the esophagus, making tracheoesophageal compression and subsequent symptoms possible. However, the vessel's diameter of approximately 17.5mm indicates no kommerell diverticulum and is well below most professional societies guidelines for intervention. Additionally, no stenosis of the trachea was noted at the level of the ARSA. As such, it is unlikely that the vessel contributed to the development of the patient's pneumonia, but may have caused some mild dysphagia. It is also unlikely that surgical intervention would have been helpful to this patient. Although this data is not currently available, if the patient suffered from recurrent LRIs, this case study may suggest that an ARSA without a kommerell diverticulum or below the level of intervention, can contribute to recurrent LRIs. earlier surgical intervention could have reduced the need for antibiotic exposure, thereby lowering the risk of contracting C Difficile. However, more data from patient records would be needed to make this argument.

LIMITATIONS OF REPORT

No clinical details were known from the subjects' medical record. No morphometric measurements were taken to justify the altered geometry of the variant vessels. Some of the studies used in this report utilized both right and left aberrant subclavian arteries, particularly in regards to the pathophysiology of komerrell's diverticulum. However, given the similarity of the conditions (anatomical course, propensity for dilatation and similar presenting symptoms) and a very limited number of reports involving only aberrant right subclavian arteries, this was deemed to be warranted by the authors. Given that the measurements taken for

this report were from a preserved cadaver it is likely that the current vessel is somewhat smaller than what it was when this person was living. This must be considered when comparing our measurements with measurements from other studies which have utilized radiologic imaging (typically computerized tomography). Given that symptoms typically emerge at diameters of 30mm or greater, it is unlikely this patient experienced symptoms. It is still possible that some degree of compression and clinical significant symptoms occurred, as some reports have documented symptoms and intervention with smaller diverticula (Erben et al., 2020; Tanaka et al., 2015).

CONCLUSIONS

The discovery of an aberrant right subclavian artery (ARSA) during cadaveric dissection underscores the critical importance of thorough anatomical examination and awareness of potential variations in medical education. Literature supports the educational value of such findings. A systematic review and meta-analysis of aortic arch variations highlighted the importance of understanding these variants for clinical practice (Polguj et al., 2014). Contemporary management of ARSA emphasizes the need for individualized treatment based on symptoms and complications. Asymptomatic patients with nonaneurysmal ARSA may be safely observed, with surveillance of vessel diameter changes recommended. The importance of anatomical knowledge in radiological interpretation of aortic arch variations has been demonstrated. This experience reinforces the need for careful observation and the ability to correlate anatomical findings with potential clinical implications. Furthermore, it highlights the ongoing relevance of cadaveric studies in complementing modern imaging techniques for comprehensive anatomical education, preparing future clinicians to recognize and manage this significant vascular variant. As a closing note, many medical schools currently debate the value of maintaining human cadaver labs when virtual anatomy learning tools are available (Fox et al., 2022; Koney et al., 2024)). This experience serves as a valuable consideration in favor of retaining human cadaver labs. The students involved (many of the authors) could not have had this experience and subsequently written this paper if they had only learned anatomy through a standardized virtual model. This case study served as a valuable learning opportunity for medical students, emphasizing the prevalence and clinical significance of anatomical variations and encouraging deeper investigation of the subject matter.

REFERENCES

1. Bath, J., D'Oria, M., Rogers, R. T., Colglazier, J. J., Braet, D. J., Coleman, D. M., Scali, S. T., Back, M. R., Magee, G. A., Plotkin, A., Dueppers, P., Zimmermann, A., Afifi, R. O., Khan, S., Zarkowsky, D., Dyba, G., Soult, M. C., Mani, K., Wanhainen, A., … Woo, K. (2023). Contemporary outcomes after treatment of aberrant subclavian artery and Kommerell's diverticulum. *Journal of Vascular Surgery*, *77*(5), 1339-1348.e6. https://doi.org/10.1016/j.jvs.2023.01.014
2. Dong, S., Alarhayem, A. Q., Meier, G., Hardy, D. M., Lyden, S. P., & Farivar, B. S. (2022). Contemporary management and natural history of aberrant right subclavian artery. *Journal of Vascular Surgery*, *75*(4), 1343-1348.e2. https://doi.org/10.1016/j.jvs.2021.11.051
3. Erben, Y., Brownstein, A. J., Velasquez, C. A., Li, Y., Rizzo, J. A., Mojibian, H., Tanweer, M., Zafar, M. A., Ziganshin, B. A., & Elefteriades, J. A. (2020). Natural history and management of Kommerell's diverticulum in a single tertiary referral center. *Journal of Vascular Surgery*, *71*(6), 2004–2011. https://doi.org/10.1016/j.jvs.2019.08.260
4. Fox, A. L., Dallaghan, G. L. B., & Gilliland, K. O. (2022). The Effectiveness of a Virtual Anatomy Curriculum Versus Traditional Cadaveric Dissection in UNC SOM's First-Year Class. *Medical Science Educator*, *32*(6), 1319–1321. https://doi.org/10.1007/s40670-022-01646-2
5. Grabenwöger, M., Alfonso, F., Bachet, J., Bonser, R., Czerny, M., Eggebrecht, H., Evangelista, A., Fattori, R., Jakob, H., Lönn, L., Nienaber, C. A., Rocchi, G., Rousseau, H., Thompson, M., Weigang, E., & Erbel, R. (2012). Thoracic Endovascular Aortic Repair (TEVAR) for the treatment of aortic diseases: A position statement from the European Association for Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI). *European Heart Journal*, *33*(13), 1558–1563. https://doi.org/10.1093/eurheartj/ehs074
6. Koney, N. K.-K., Ansah, A. O., Asaku, B. N. A., Ahenkorah, J., Hottor, B. A., Adutwum-Ofosu, K., Abdul-Rahman, M., & Arko-Boham, B. (2024). Anatomage virtual dissection versus traditional human body dissection in anatomy pedagogy: Insights from Ghanaian medical students. *BMC Medical Education*, *24*(1), 1059. https://doi.org/10.1186/s12909-024-06029-2
7. Krupiński, M., Irzyk, M., Moczulski, Z., Banyś, R., Dwojak, I., & Urbańczyk-Zawadzka, M. (2019). CT evaluation of aberrant right subclavian artery: Anatomy and clinical implications. *Cardiology in the Young*, *29*(2), 128–132. https://doi.org/10.1017/S1047951118001907
8. Levitt, B., & Richter, J. E. (2007). Dysphagia lusoria: A comprehensive review. *Diseases of the Esophagus: Official Journal of the International Society for Diseases of the Esophagus*, *20*(6), 455–460. https://doi.org/10.1111/j.1442-2050.2007.00787.x
9. Loschi, D., Santoro, A., Rinaldi, E., Bilman, V., Chiesa, R., & Melissano, G. (2023). A systematic review of open, hybrid, and endovascular repair of aberrant subclavian artery and Kommerell's diverticulum treatment. *Journal of Vascular Surgery*, *77*(2), 642-649.e4. https://doi.org/10.1016/j.jvs.2022.07.010

10. Polguj, M., Chrzanowski, Ł., Kasprzak, J. D., Stefańczyk, L., Topol, M., & Majos, A. (2014). The Aberrant Right Subclavian Artery (Arteria Lusoria): The Morphological and Clinical Aspects of One of the Most Important Variations—A Systematic Study of 141 Reports. *The Scientific World Journal*, *2014*, 292734. https://doi.org/10.1155/2014/292734

11. Scala, C., Leone Roberti Maggiore, U., Candiani, M., Venturini, P. L., Ferrero, S., Greco, T., & Cavoretto, P. (2015). Aberrant right subclavian artery in fetuses with Down syndrome: A systematic review and meta-analysis. *Ultrasound in Obstetrics & Gynecology*, *46*(3), 266–276. https://doi.org/10.1002/uog.14774

12. Tallarita, T., Rogers, R. T., Bower, T. C., Stone, W., Farres, H., Money, S. R., & Colglazier, J. J. (2023). Characterization and surgical management of aberrant subclavian arteries. *Journal of Vascular Surgery*, *77*(4), 1006–1015. https://doi.org/10.1016/j.jvs.2022.12.018

13. Tanaka, A., Milner, R., & Ota, T. (2015). Kommerell's diverticulum in the current era: A comprehensive review. *General Thoracic and Cardiovascular Surgery*, *63*(5), 245–259. https://doi.org/10.1007/s11748-015-0521-3

14. Upchurch, G. R., Escobar, G. A., Azizzadeh, A., Beck, A. W., Conrad, M. F., Matsumura, J. S., Murad, M. H., Perry, R. J., Singh, M. J., Veeraswamy, R. K., & Wang, G. J. (2021). Society for Vascular Surgery clinical practice guidelines of thoracic endovascular aortic repair for descending thoracic aortic aneurysms. *Journal of Vascular Surgery*, *73*(1), 55S-83S. https://doi.org/10.1016/j.jvs.2020.05.076

15. Wang, P., Wang, Q., Bai, C., & Zhou, P. (2020). Iatrogenic aortic dissection following transradial coronary angiography in a patient with an aberrant right subclavian artery. *The Journal of International Medical Research*, *48*(8), 0300060520943789. https://doi.org/10.1177/0300060520943789

Citation: Erik Morales, Hawkins Sellier, et al., "An Aberrant Right Subclavian Artery: A Cadaveric Case Study", American Research Journal of Anatomy, Vol 1, no. 1, 2025, pp. 1-4.