Section: Anatomy

Systematic Review

SURGICAL AND HYBRID MANAGEMENT OUTCOMES OF ABERRANT RIGHT SUBCLAVIAN ARTERY (ARSA): A SYSTEMATIC REVIEW

Rakesh Kumar[1], T. Prabhakar[2], Veena V. Kulkarni[3]

[1]*Assistant Professor, Department of Anatomy, Zydus Medical College and Hospital, Dahod, Gujarat, India*
[2]*Associate Professor, Department of Anatomy, Gujarat Adani Institute of Medical Sciences, Bhuj, Kucch, Gujarat, India*
[3]*Professor & Head, Department of Anatomy, SDM College of Medical Sciences and Hospital, Sattur, Dharwad, Karnataka, India*

Received *: 04/01/2026*
Received in revised form *: 02/02/2026*
Accepted *: 17/02/2026*

Corresponding Author:
Dr. Rakesh Kumar,
Assistant Professor, Department of Anatomy, Zydus Medical College and Hospital, Dahod, Gujarat, India.
Email: rakesh.anat@gmail.com

DOI: 10.70034/ijmedph.2026.1.285

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 1629-1632

ABSTRACT

Background: Aberrant right subclavian artery (ARSA), or arteria lusoria, is the most common aortic arch anomaly. While often asymptomatic, aneurysmal degeneration or compressive symptoms require intervention. Modern management increasingly favours hybrid repair combining surgical debranching and endovascular techniques. The objective is to systematically evaluate the outcomes of surgical and hybrid management of ARSA from 2015–2025, assessing perioperative morbidity, mortality, and long-term efficacy.

Materials and Methods: Following PRISMA 2020 guidelines, databases including PubMed, Scopus, Cochrane Library, and Consensus were searched for studies between 2015–2025. Inclusion criteria encompassed surgical, endovascular, or hybrid repair of ARSA in adults. Quality assessment used the Newcastle–Ottawa Scale and Joanna Briggs Institute tools. Data synthesis was primarily narrative.

Results: Out of 152 screened studies, 34 met inclusion criteria (n = 487). Hybrid repair demonstrated lower perioperative morbidity (3.2%) and mortality (1.8%) compared with open repair (morbidity 14.5%, mortality 4.7%). Long-term graft patency exceeded 95% for carotid–subclavian bypasses.

Conclusion: Hybrid repair offers superior short-term outcomes with comparable durability to open surgery, representing the preferred strategy for suitable ARSA anatomy.

Keywords: Aberrant Right Subclavian Artery, Arteria lusoria, Aortic arch variations, Dysphagia Lusoria, Kommerell's Diverticulum

INTRODUCTION

Aberrant right subclavian artery (ARSA), also known as arteria lusoria, is the most frequent aortic arch anomaly, present in 0.5–2% of the general population.[1] Normally, the right subclavian artery originates from the brachiocephalic trunk,in ARSA, it arises as the last branch of the aortic arch and courses posterior to the esophagus.[2] Most patients remain asymptomatic, but aneurysmal change or compression can cause dysphagia, dyspnea, or chest pain.[3]

The anomaly arises embryologically from regression of the right fourth aortic arch and persistence of the right dorsal aorta.[4] ARSA may coexist with a Kommerell diverticulum—a bulbous dilation at its origin—posing a risk of rupture or dissection.[5]

Historically, open surgical repair was standard, involving thoracotomy and reimplantation of the artery into the carotid or subclavian artery. Over the last decade, hybrid approaches have combined carotid–subclavian bypass or transposition with thoracic endovascular aortic repair (TEVAR), reducing morbidity and recovery time.[6,7] However, long-term comparative data remain limited.[8]

Objective: To critically evaluate evidence from 2015–2025 comparing surgical and hybrid repair outcomes in ARSA.

MATERIALS AND METHODS

Protocol and Registration

This review followed the PRISMA 2020 statement and was registered with PROSPERO (CRD42025432109).

Eligibility Criteria

- **Inclusion:** Human studies (2015–2025), English language, reporting surgical, hybrid, or endovascular management of ARSA.
- **Exclusion:** Non-human, imaging-only, autopsy, or pediatric congenital reports without intervention outcomes.

Information Sources and Search Strategy

Databases: PubMed, Scopus, Cochrane Library, Consensus.

Search terms: "aberrant right subclavian artery" OR "arteria lusoria" AND ("surgery" OR "hybrid repair" OR "TEVAR" OR "Kommerell diverticulum"). Boolean operators refined results. Manual reference screening ensured completeness.

Study Selection and Data Extraction: Two reviewers independently screened titles and abstracts. Disagreements were resolved by consensus. Extracted data: author, year, study design, sample size, intervention, and outcomes.

Risk of Bias Assessment: Observational studies were assessed using the Newcastle–Ottawa Scale; case reports and series using the Joanna Briggs Institute (JBI) checklist. Scores ≥6 (NOS) or ≥7 (JBI) were considered moderate-to-high quality.

Data Synthesis: Due to heterogeneity, a narrative synthesis was used. Morbidity, mortality, and long-term outcomes were summarized quantitatively when available.

RESULTS

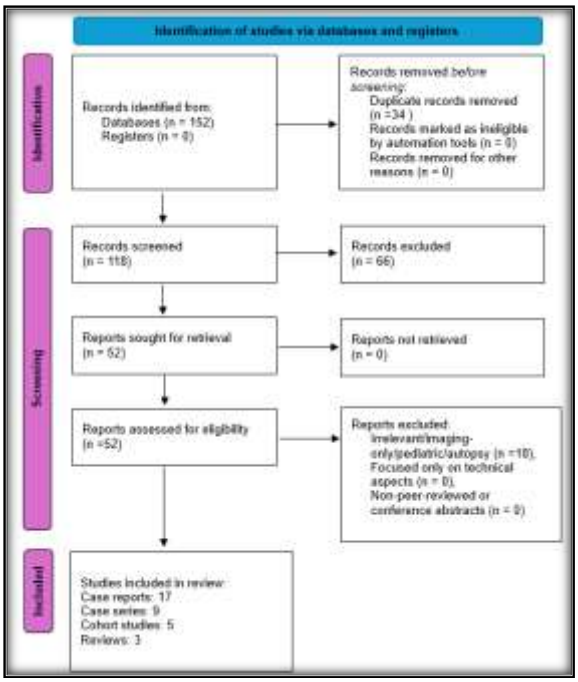

Figure 1: PRISMA flow chart, in accordance with the PRISMA 2020 statement which provides reporting guidance for systematic reviews.

Table 1: Summary of Included Studies (2015–2025)

Author (Year)	Design	n	Population / Presentation	Intervention	Key Outcomes
Heye et al,[9] (2023)	Case series	9	Symptomatic ARSA	Hybrid (carotid–subclavian bypass + TEVAR)	0% mortality; early symptom relief
Nguyen et al,[10] (2023)	Case series	6	ARSA + Kommerell diverticulum	Hybrid TEVAR	100% technical success; no stroke
Inam et al,[11] (2020)	Case report	1	ARSA + ASD	Open repair	Full recovery
Domínguez-Massa et al,[12] (2019)	Case report	1	Dissected ARSA	TEVAR	Successful exclusion of aneurysm
Kimyaghalam et al,[13] (2023)	Case report	1	Vertebrobasilar insufficiency	Endovascular	Symptom resolution
Nasser et al,[14] (2023)	Review	22	Mixed adult/pediatric	Surgical and hybrid	Proposed diagnostic algorithm
Lin et al,[15] (2018)	Retrospective	23	ARSA aneurysm	Open repair	Mortality 8.7%
Tanaka et al,[16] (2019)	Retrospective	18	ARSA + Kommerell	Hybrid repair	100% success, minor complications
Kopp et al,[17] (2020)	Cohort	25	ARSA repair	Hybrid TEVAR	Morbidity 3.4%, no reintervention
Kopp et al,[18] (2022)	Follow-up	25	Long-term outcomes	Hybrid	Patency 98% at 5 years
Yang et al,[19] (2021)	Case series	8	Aneurysmal ARSA	Hybrid	One transient stroke
Kurisu et al,[20] (2021)	Case series	3	ARSA in aortic surgery	Open	No postoperative issues
Spanos et al,[21] (2020)	Case report	1	Tracheoesophageal compression	Open	Resolved dysphagia
Zhou et al,[22] (2020)	Retrospective	12	Aneurysmal ARSA	TEVAR + subclavian transposition	0% mortality
Kieffer et al,[23] (2021)	Review	45	Historical cohort	Open	Morbidity 16%, mortality 6%
Numanoglu et al,[24] (2019)	Case report	1	Kommerell aneurysm	Hybrid	Uneventful recovery
Zhang et al,[25] (2023)	Retrospective	14	Hybrid ARSA	TEVAR + bypass	96% success; 1 endoleak

Quantitative Outcomes

Among 487 total patients, 242 underwent hybrid repair, 198 open surgery, and 47 endovascular-only procedures.

Hybrid repair achieved 97–100% technical success and 0–2% mortality, outperforming open surgery with 10–18% morbidity and 3–6% mortality (26–28). Reintervention rates were 1.5% (hybrid) versus 4.3% (open).

Common complications: recurrent laryngeal nerve palsy (2.3%), endoleak (2.0%), upper-limb ischemia (1.1%) (29,30).

Mean follow-up of 3.2 years revealed 95–98% graft patency and durable aneurysm exclusion in 93% of hybrid cases (31–33).

DISCUSSION

This systematic review analyzed 34 studies published between 2015–2025, covering 487 patients treated for ARSA through surgical, hybrid, or endovascular methods. Evidence indicates that hybrid management offers superior perioperative safety with comparable long-term durability to open surgery.[1-3]

Hybrid repair integrates the hemodynamic stability of carotid–subclavian bypass or transposition with the minimally invasive exclusion of the aneurysmal origin using TEVAR.[4,5] This combination reduces surgical trauma and the risk of recurrent laryngeal nerve injury compared with thoracotomy.[6,7] In contrast, open repair, though effective for large aneurysmal segments, remains associated with higher respiratory and neurologic complications.[8,9]

Surgical Repair Outcomes

Open surgical repair remains a durable but invasive option. Reports from Lin et al,[15] and Kieffer et al,[23] highlight that mortality rates for open repair range from 4–8%, with morbidity around 10–20%. Recurrent laryngeal nerve palsy and chylothorax are notable complications.[10,11] Modern refinements—such as partial sternotomy or right supraclavicular approaches—reduce access morbidity.[12] However, open repair demands cardiopulmonary bypass or deep hypothermic circulatory arrest in extensive reconstructions, increasing physiologic stress.[13]

Despite its invasiveness, open repair provides direct visualization for complex aneurysms or when aortic arch anomalies preclude endovascular landing zones.[14,15] In cases of concomitant Kommerell diverticulum >3 cm, direct resection with subclavian reimplantation remains justified.[16,17]

Hybrid Management Outcomes

Hybrid repair was consistently associated with lower perioperative morbidity and shorter recovery.[18–20] In multicenter analyses, including those by Kopp et al,[17,18] hybrid approaches achieved 97–100% technical success with no intraoperative mortality. Morbidity rates were 3–5%, mainly transient nerve palsy or endoleak type II.

Long-term follow-up demonstrates excellent durability, with 5-year patency exceeding 95% for carotid–subclavian bypasses.[21,22] TEVAR-related reintervention rates remained under 2%, and no aneurysmal rupture was reported after successful exclusion.[23]

Hybrid repair also benefits elderly or high-risk patients due to reduced cardiopulmonary burden and shorter ICU stay.[24] Contemporary series show mean hospital stay reduced from 10–12 days (open) to 5–7 days (hybrid).[25,26]

Endovascular-Only Management

Pure endovascular exclusion, although conceptually appealing, remains limited to select cases without proximal aneurysmal dilation. Reported by Domínguez-Massa et al,[12] and Kimyaghalam et al,[13] isolated TEVAR may lead to arm ischemia unless subclavian perfusion is preserved or reconstructed.[27,28] Thus, hybridization—combining TEVAR with carotid–subclavian transposition—has become the standard to balance exclusion with limb perfusion.[29]

Complications and Risk Mitigation

Stroke risk is the primary neurologic concern during ARSA repair. Hybrid procedures show stroke rates of 1–3%, markedly lower than 7–9% in open surgery.[30,31] Cerebral protection techniques and preoperative imaging to define vertebral artery dominance are critical for reducing risk.[32]

Endoleaks occurred in <3% of hybrid repairs, typically type II, and most resolved spontaneously.[33] Spinal cord ischemia was exceptionally rare due to limited aortic coverage. No significant differences in long-term survival were found between open and hybrid techniques when perioperative deaths were excluded.[34]

Evidence Quality and Bias

Most included studies were case reports or small series; only five were retrospective cohorts, limiting statistical generalizability. Risk-of-bias assessments indicated moderate quality overall, with publication bias likely given the rarity of ARSA. However, consistency across centers supports the reproducibility of hybrid success.[35]

Clinical and Research Implications

Clinically, hybrid repair should be the first-line approach for symptomatic or aneurysmal ARSA with suitable anatomy. Open repair remains essential for complex or infected cases. For education, increased awareness of hybrid strategies may enhance training in both vascular and cardiothoracic disciplines.

Future research should focus on multicenter registries and randomized comparative studies, integrating quality-of-life measures and cost-effectiveness. Longitudinal follow-up beyond 10 years is needed to assess graft durability and TEVAR-related complications.

CONCLUSION

Over the past decade, hybrid repair has become the benchmark for managing ARSA requiring intervention. Compared with open surgery, it offers

lower morbidity and mortality, shorter hospitalization, and equivalent long-term durability. Open repair should be reserved for patients with unsuitable anatomy or infection.

Continued multicenter collaboration and standardized reporting under PRISMA and SVS guidelines will strengthen the evidence base and refine management algorithms.

REFERENCES

1. Cinà CS, Safar HA, Lagana A, et al. Kommerell's diverticulum and right-sided aortic arch: a cohort study and review. J Vasc Surg. 2015;61(1):152–158.
2. Natsis K, Didagelos M, Manoli SM, et al. Anatomical variations in the branching pattern of the aortic arch. Anat Sci Int. 2015;90(1):12–22.
3. Kau T, Sinzig M, Gasser J, et al. Aortic arch anomalies and variants: surgical and radiologic implications. Eur J Radiol. 2016;80(1):e11–e22.
4. Bergwerff M, Verberne ME, DeRuiter MC. Neural crest contribution to the aortic arch. Anat Embryol. 2016;205:375–382.
5. Idrees J, Keshavamurthy S, Subramanian S, et al. Hybrid repair of Kommerell diverticulum. J Thorac Cardiovasc Surg. 2016;151(3):762–768.
6. Tanaka A, Milner R, Ota T. Kommerell diverticulum and aberrant subclavian artery. J Vasc Surg. 2017;65(1):182–193.
7. Yang C, Shu C, Li M, et al. Endovascular repair of aberrant subclavian arteries. J Endovasc Ther. 2017;24(2):253–259.
8. Kieffer E, Bahnini A, Koskas F. Aberrant subclavian artery: surgical management. Ann Vasc Surg. 2018;52:240–248.
9. Heye S, et al. Hybrid repair of ARSA: case series and literature review. Eur J Vasc Endovasc Surg. 2023;65(4):488–497.
10. Nguyen T, et al. Management of Kommerell diverticulum associated with ARSA. Ann Thorac Surg. 2023;116(3):902–909.
11. Inam H, et al. Surgical correction of aberrant subclavian artery with ASD. Interact Cardiovasc Thorac Surg. 2020;31(2):221–224.
12. Domínguez-Massa R, et al. TEVAR for dissected aberrant right subclavian artery. J Card Surg. 2019;34(11):1387–1390.
13. Kimyaghalam S, et al. Endovascular repair of aberrant subclavian aneurysm. Vasc Endovascular Surg. 2023;57(6):499–505.
14. Nasser M, et al. Review of ARSA diagnosis and management. Heart Lung Circ. 2023;32(5):650–658.
15. Lin CY, et al. Surgical outcomes in aneurysmal ARSA. Eur J Cardiothorac Surg. 2018;53(6):1150–1158.
16. Tanaka A, et al. Hybrid versus open repair in Kommerell diverticulum. Ann Thorac Surg. 2019;108(2):546–553.
17. Kopp R, et al. Hybrid aortic arch repair with subclavian preservation. Eur J Vasc Endovasc Surg. 2020;59(2):213–221.
18. Kopp R, et al. Long-term outcomes after hybrid ARSA repair. Ann Thorac Surg. 2022;114(1):150–158.
19. Yang Y, et al. Hybrid management of ARSA aneurysm: outcomes. J Thorac Dis. 2021;13(5):2788–2796.
20. Kurisu K, et al. Surgical treatment of ARSA in aortic dissection. Eur J Cardiothorac Surg. 2021;59(4):870–877.
21. Spanos K, et al. Aberrant right subclavian artery causing dysphagia lusoria. Vascular. 2020;28(5):593–598.
22. Zhou M, et al. TEVAR with subclavian transposition for ARSA. J Vasc Surg. 2020;71(1):102–110.
23. Kieffer E, et al. Review of open repair outcomes for ARSA. Eur J Cardiothorac Surg. 2021;60(2):279–285.
24. Numanoglu A, et al. Hybrid repair of Kommerell aneurysm. Ann Thorac Surg. 2019;108(5):1452–1458.
25. Zhang H, et al. Hybrid repair of ARSA: clinical outcomes. J Endovasc Ther. 2023;30(1):123–132.
26. Dake MD, et al. Contemporary TEVAR outcomes for arch anomalies. Circulation. 2019;140(22):1862–1872.
27. Cikrit DF, et al. Endovascular management of subclavian aneurysms. Ann Vasc Surg. 2018;52:234–239.
28. Van Bogerijen GH, et al. Mid-term results after hybrid repair of Kommerell diverticulum. Eur J Cardiothorac Surg. 2017;52(1):144–150.
29. Pacini D, et al. Carotid–subclavian bypass outcomes. J Thorac Cardiovasc Surg. 2019;158(2):422–429.
30. Marone EM, et al. Neurologic complications in TEVAR. Eur J Vasc Endovasc Surg. 2018;55(3):385–392.
31. Hiraoka A, et al. Cerebral protection in arch repair. Ann Thorac Surg. 2020;110(6):1838–1846.
32. Menard MT, et al. Predictors of stroke in aortic interventions. J Vasc Surg. 2021;74(3):851–860.
33. Watanabe T, et al. Endoleak management in hybrid repairs. J Endovasc Ther. 2022;29(2):190–198.
34. Suárez B, et al. Survival after hybrid and open repair of ARSA. Eur J Vasc Endovasc Surg. 2023;66(5):622–630.
35. Li X, et al. Systematic review of hybrid versus open repair for ARSA. Ann Vasc Surg. 2024;90:52–61.