Yasui procedure with aberrant right subclavian artery patch for interrupted aortic arch (Type B)

Vivek Bagaria[1,2], Arul Narayanan[3], Michael Bowes[3], Attilio Lotto[1,2,4]

[1] Department of Paediatric Cardiac Surgery, Alder Hey Children's Hospital, Liverpool, UK.
[2] Faculty of Health, Liverpool John Moores University, Liverpool, UK.
[3] Department of Paediatric Cardiology, Alder Hey Children's Hospital, Liverpool, UK.
[4] Liverpool Centre for Cardiovascular Science, University of Liverpool, Liverpool, UK.

Corresponding Author
Mr. Attilio Lotto
Consultant Congenital Cardiac Surgery
Alder Hey Children's Hospital
E Prescot Road
Liverpool – L145AB
attilio.lotto@alderhey.nhs.uk

Meeting presentation – European Congenital Heart Surgeons Association (ECHSA) annual meeting, Munich, Germany, 2025.

Abstract

Reconstructing an interrupted aortic arch requiring a Damus-Kaye-Stansel (DKS) anastomosis can result in “gothic arch” formation due to extensive aortic mobilization, further complicated by an anomalous right subclavian artery (abRSCA). We describe using a free abRSCA patch (rather than pedicled flap) to reconstruct the posterior aortic arch in two infants undergoing staged Yasui procedure for interrupted aortic arch (Type B) with hypoplastic left ventricular outflow tract. The harvested abRSCA was opened longitudinally and fashioned into a patch to bridge the posterior aortic gap, with anterior reconstruction completed using pulmonary homograft patch. Postoperative CT scans confirmed smooth, rounded arch anatomy without gothic appearance. This free patch modification provided greater surgical flexibility compared to previously described pedicled flap techniques while achieving excellent mid-term anatomical outcomes optimized for subsequent DKS anastomosis.

Keyword – *Interrupted aortic arch, Aberrant right subclavian artery, Yasui procedure, DKS anastomosis*

Background

Reconstructing an interrupted aortic arch requiring DKS anastomosis, as in Yasui Stage I, demands extensive aortic mobilization that can result in gothic arch formation. The presence of an abRSCA further complicates the procedure, often necessitating its sacrifice. We describe using a free abRSCA segment to reconstruct the posterior arch, providing greater surgical flexibility while achieving harmonious arch curvature and tension-free DKS anastomosis.

Case Summary

A 2.48-kg girl and a 2.8-kg boy presented with interrupted aortic arch (Type B), hypoplastic left ventricular outflow tract, and abRSCA. Both underwent staged Yasui procedures. Staging was chosen due to low birth weight (<3 kg) and, in the second patient, CHARGE syndrome with associated comorbidities.

During stage 1 Norwood-type procedure, Sano-type shunt (right ventricle to pulmonary artery using 5-mm non-valved PTFE conduit) provided pulmonary blood flow. The abRSCA, arising from proximal descending aorta, was harvested as a free graft after ligation and division, then opened longitudinally to create a patch measuring approximately 1.5 cm × 1.0 cm. This free patch technique, rather than maintaining a pedicled flap, provided greater positioning flexibility and optimized arch geometry for subsequent DKS anastomosis. The autologous arterial patch reconstructed the posterior interrupted aorta, bridging the gap between left carotid and left subclavian arteries. Anterior arch augmentation used pulmonary homograft patch, with main pulmonary artery anastomosed centrally using reimplantation technique.(1) (Figure 1 and Supplementary Figure 1)

Late postoperative CT imaging showed well-reconstructed aortic arches with smooth, round appearance without “gothic” shape (Figure 2). The first patient progressed well, underwent successful Yasui stage 2, and was discharged home. The second patient with CHARGE syndrome developed high left ventricular end-diastolic pressures and pulmonary hypertension; care was redirected to palliative measures.

Discussion

Gothic arch formation after interrupted aortic arch repair is linked to late hypertension and bronchial compression.(2,3) Augmenting the lesser curvature with autologous tissue creates a Roman-shaped arch associated with lower reintervention rates (86% freedom at 10 years) and reduced bronchial complications.(3–5)

Various autologous tissues have been employed for arch augmentation, including pulmonary artery wall, left subclavian artery, and abRSCA.(3,5–7) Bacha et al. used abRSCA as a pedicled flap to preserve vascular supply and growth potential.(6) However, in Yasui procedures requiring extensive mobilization and adequate space for DKS anastomosis, we found the free patch technique offered distinct advantages. The posterior abRSCA origin and Type B IAA anatomy made maintaining a viable pedicled flap technically challenging while achieving optimal arch curvature. Additionally, a free patch provided greater positioning flexibility necessary for creating adequate transverse arch space for DKS anastomosis. Combined with anterior homograft augmentation, this approach achieved excellent mid-term CT outcomes, suggesting that favourable anatomical results can be obtained despite theoretical concerns about compromised vascular supply in free patches. The necessarily

sacrificed abRSCA bridged the gap between carotid and subclavian arteries, enabling tension-free completion with appropriate geometry for subsequent DKS anastomosis.

Conclusion

In these staged Yasui procedures, free abRSCA patch successfully reconstructed the interrupted arch, creating rounded aortic anatomy optimized for DKS anastomosis. This modification provided greater surgical flexibility than pedicled flap techniques in this specific context and achieved excellent mid-term outcomes. Longer follow-up is needed to assess growth and durability.

Acknowledgement

We are grateful to Dr G. Ricciardi, Hospital Jeanne de Flandres, Lille – France, for the clear diagrams highlighting the key surgical steps

Data Availability Statement – The data underlying this article are available in the article and in its online supplementary material.

Ethical Statement – Consent for publication was obtained via telephone from both patients' parents, and this information was documented in their electronic medical records.

Conflict of Interest – None declared

Funding statement – None

Author contribution statement –

Vivek Bagaria – Data curation, visualisation and writing – original draft

Arul Narayanan – Writing – review & editing

Michael Bowes – Writing – review & editing

Attilio Lotto – Conceptualization, supervision and writing – review & editing

Figure Legend

Figure 1 – Diagrams showing the key surgical steps.

(a) Detached and harvested aberrant right subclavian artery (ARSCA) opened longitudinally forming rectangular patch. (b,c) ARSCA patch bridges the gap between ascending and descending aorta forming transverse arch back-wall. (d) Arch repair completed using anterior homograft patch and Sano shunt from right ventricle to pulmonary bifurcation.

Figure 2: Pre- and post-operative 3D-reconstructed CT images demonstrating arch architecture. Triangle indicates aberrant right subclavian artery.

References

1. Barron DJ, Selvabaskaran A, Yoo SJ, Yap KH, Brawn WJ. Aortic Arch Reconstruction in the Norwood Procedure: The “Reimplantation” Technique. *Oper Tech Thorac Cardiovasc Surg*. 2024;29(1):37-53. doi:10.1053/j.optechstcvs.2023.09.002
2. Ou P, Celermajer DS, Raisky O, et al. Angular (Gothic) aortic arch leads to enhanced systolic wave reflection, central aortic stiffness, and increased left ventricular mass late after aortic coarctation repair: Evaluation with magnetic resonance flow mapping. *J Thorac Cardiovasc Surg*. 2008;135(1):62-68. doi:10.1016/j.jtcvs.2007.03.059
3. Seo DM, Park J, Goo HW, Kim YH, Ko JK, Jhang WK. Surgical modification for preventing a gothic arch after aortic arch repair without the use of foreign material. *Interact Cardiovasc Thorac Surg*. 2015;20(4):504-509. doi:10.1093/icvts/ivu442
4. Lee SO, Shin HJ, Jun TG, et al. Midterm results of arch augmentation with autologous vascular patch in interrupted aortic arch. *EJCTS*. 2022;62(1). doi:10.1093/ejcts/ezab558
5. Lee H, Yang JH, Jun TG, et al. Augmentation of the Lesser Curvature with an Autologous Vascular Patch in Complex Aortic Coarctation and Interruption. *Ann Thorac Surg*. 2016;101(6):2309-2314. doi:10.1016/j.athoracsur.2016.01.017
6. Bacha EA, Sawaqed R. Use of the Aberrant Right Subclavian Artery in Complex Aortic Arch Reconstruction. *Annals of Thoracic Surgery*. 2007;83(4):1566-1568. doi:10.1016/j.athoracsur.2006.05.084
7. Maekawa Y, Sakamoto T, Umezu K, Ohashi N, Harada Y. Aortic arch reconstruction for interrupted aortic arch using an aberrant right subclavian artery. *Gen Thorac Cardiovasc Surg*. 2013;61(2):108-110. doi:10.1007/s11748-012-0171-7

8. Roussin R, Belli E, Lacour-Gayet F, et al. Aortic arch reconstruction with pulmonary autograft patch aortoplasty. *J Thorac Cardiovasc Surg*. 2002;123(3):443-450. doi:10.1067/mtc.2002.120733