GLOBAL CARDIOLOGY SCIENCE AND PRACTICE

New surgical technique for repairing ALCAPA originating from the non-facing pulmonary sinus: The Aswan Drawbridge technique

Amr Alsalakawy, Ahmed Mahgoub, Amr Elsawy, Islam Rashwan, Mohamed Adel, Ahmed Afifi, Hatem Hosny, Magdi Yacoub

DOI:	https://doi.org/10.21542/gcsp.2026.42
VOLUME:	2026
ISSUE:	5
ARTICLE:	42
PMC PUBLICATION DATE:	31 Oct 2026
PMC COLLECTION DATE:	31 Oct 2026
PMC ARTICLE TYPE:	case-report
ARTICLE TYPE:	Surgical techniques
SUBMITTED:	01 Sep 2026
ACCEPTED:	13 Oct 2026
RUNNING HEAD:	Alsalakawy et al., GCSP 2026:42

CITE THIS ARTICLE AS: Alsalakawy A, Mahgoub A, Elsawy A, Rashwan I, Adel M, Afifi A, Hosny H, Yacoub M. New surgical technique for repairing ALCAPA originating from the non-facing pulmonary sinus: The Aswan Drawbridge technique, Global Cardiology Science and Practice 2026:42 https://doi.org/10.21542/gcsp.2026.42

COPYRIGHT: 2026 The Author(s), licensee Magdi Yacoub Institute. This is an open access article distributed under the terms of the Creative Commons Attribution license CC BY-4.0, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

Please note this is an 'Article in Press' and will be replaced with a typeset PDF & PubMed Central deposit in the coming weeks.
Citation details and DOI will remain the same.

Surgical techniques

New surgical technique for repairing ALCAPA originating from the non-facing pulmonary sinus: The Aswan Drawbridge technique

Amr Alsalakawy[1*], Ahmed Mahgoub[1,2], Amr Elsawy[3], Islam Rashwan[1,4], Mohamed Adel[1,5], Ahmed Afifi[1], Hatem Hosny[1], Magdi Yacoub[1,6]

1 *Cardiac Surgery Department, Aswan Heart Centre-Magdi Yacoub Foundation, Aswan, Egypt*
2 *National Heart Institute, Cairo, Egypt*
3 *Department of Biomedical Engineering and Innovation Laboratory, Aswan Heart Centre-Magdi Yacoub Foundation, Aswan, Egypt*
4 *Cardiothoracic surgery Department, Misr University for Science and Technology, Giza, Egypt.*
5 *Cardiothoracic Surgery Department, Ain Shams University, Cairo, Egypt*
6 *National Heart and Lung Institute, Imperial College London, London, UK*

*amr.alsalakawy@gmail.com

Abstract

Background: Anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA) is a rare congenital anomaly in which coronary steal causes progressive left ventricular ischemia, dysfunction, and secondary mitral regurgitation. Direct reimplantation into the aorta is the gold standard. However, it is technically hazardous when the left coronary artery (LCA) arises from the distant non-facing pulmonary sinus, because tension on the transferred vessel risks occluding it. The Takeuchi procedure is an established alternative, but it has limitations, particularly when the anomalous ostium lies close to a pulmonary valve commissure.
Technique: We describe the "Aswan Drawbridge" technique in an asymptomatic 8-year-old girl whose anomalous LCA ostium lay immediately adjacent to a pulmonary valve commissure. The commissure was partially detached to maximize the harvested coronary button. A long aortic flap was then created in the left coronary sinus and reflected inferiorly, like a drawbridge, to form the floor of the tunnel. The lateral flaps of the button were sutured to this aortic flap, creating a tension-free tunnel of autologous arterial tissue between the LCA and the aorta. The pulmonary artery defect was reconstructed with an autologous pericardial patch, and the detached commissure was resuspended to it.
Outcome: The postoperative course was uneventful, and the patient was discharged on postoperative day 7. Cardiac computed tomography at 1 month showed a patent 5-mm tunnel

without kinking, stenosis, or compression. At 3 years, the patient remained asymptomatic, with normal biventricular function and regression of mitral regurgitation from moderate to mild, consistent with left ventricular reverse remodeling.
Conclusion: The Aswan Drawbridge technique is a feasible option for ALCAPA arising from the non-facing pulmonary sinus. Longer follow-up is needed to establish the tunnel's durability.

Introduction

Anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA) is a rare congenital anomaly in which the left coronary artery (LCA) arises from the main pulmonary artery (MPA) instead of the aorta. Once pulmonary vascular resistance falls after birth, coronary steal develops. Blood from the right coronary artery, at systemic pressure, flows through collaterals into the LCA and then backwards into the low-pressure pulmonary circulation. The result is progressive left ventricular ischemia, dysfunction, and secondary mitral regurgitation[1].

Surgical repair is the definitive treatment. Several techniques have been described, but direct reimplantation of the LCA into the aorta remains the gold standard because it restores a dual coronary system with normal anatomy and physiology[2]. Direct reimplantation is not always technically feasible, however, particularly when the LCA arises from the non-facing pulmonary sinus[3]. In such cases, the Takeuchi procedure is an established alternative[4]. It creates an aortopulmonary window and an intrapulmonary tunnel that carries aortic blood to the anomalous ostium. However, the procedure has important drawbacks, including supravalvular pulmonary stenosis and coronary-to-pulmonary artery fistula. It is also technically difficult when the LCA arises close to a pulmonary valve commissure[3].

We present the case of an 8-year-old girl with ALCAPA arising from the non-facing sinus of the MPA, with the anomalous coronary ostium immediately adjacent to a pulmonary valve commissure. This anatomy made both standard direct reimplantation and conventional Takeuchi repair technically challenging. We describe a modification of direct reimplantation that uses autologous aortic and pulmonary arterial flaps to create a tension-free arterial tunnel for such cases.

Case presentation

An asymptomatic 8-year-old girl was referred for cardiac evaluation after a systolic murmur was heard on routine physical examination. Transthoracic echocardiography showed preserved biventricular systolic function, moderate mitral regurgitation, and an LCA arising from the MPA with reversed flow in the left coronary system. Cardiac computed tomography (CT) confirmed the diagnosis and showed that the LCA arose from the non-facing sinus of the MPA, at a considerable distance from the aortic root (Figure 2A).

Operative details

The procedure was performed through a standard median sternotomy. Cardiopulmonary bypass (CPB) was established with aortic and bicaval cannulation, and the left ventricle was vented. The branch pulmonary arteries were mobilized and snared to prevent cardioplegia runoff into the

pulmonary circulation. After aortic cross-clamping, antegrade cardioplegia was delivered into the aortic root. The MPA was then transected near the bifurcation to expose the LCA ostium.

Inspection showed that the LCA ostium lay immediately adjacent to a pulmonary valve commissure. The commissure was partially detached so that the LCA could be harvested with a generous cuff of arterial wall, creating a large coronary button (Figure 1A). A further dose of cardioplegia was given directly into the LCA ostium to ensure adequate myocardial protection. The LCA was then mobilized further, but direct anastomosis to the aorta would still have placed excessive tension on the transferred artery, with a prohibitive risk of occlusion.

To overcome this, the ascending aorta was transected above the sinotubular junction. A long aortic flap was created in the left coronary sinus and reflected inferiorly, like a drawbridge, to form the floor of the tunnel (Figure 1B). The lateral flaps of the coronary button were then sutured to this aortic flap to form the roof (Figure 1C). This created an autologous arterial tunnel that connected the LCA to the aorta without tension (Figure 1D).

After the coronary reconstruction was complete, the ascending aorta was reanastomosed. The defect in the MPA was reconstructed with an autologous pericardial patch, to which the detached pulmonary valve commissure was resuspended (Figure 1C). The aortic cross-clamp was then removed, and the distal MPA anastomosis was completed on the beating heart. The patient was weaned from CPB and transferred to the intensive care unit hemodynamically stable (Video 1).

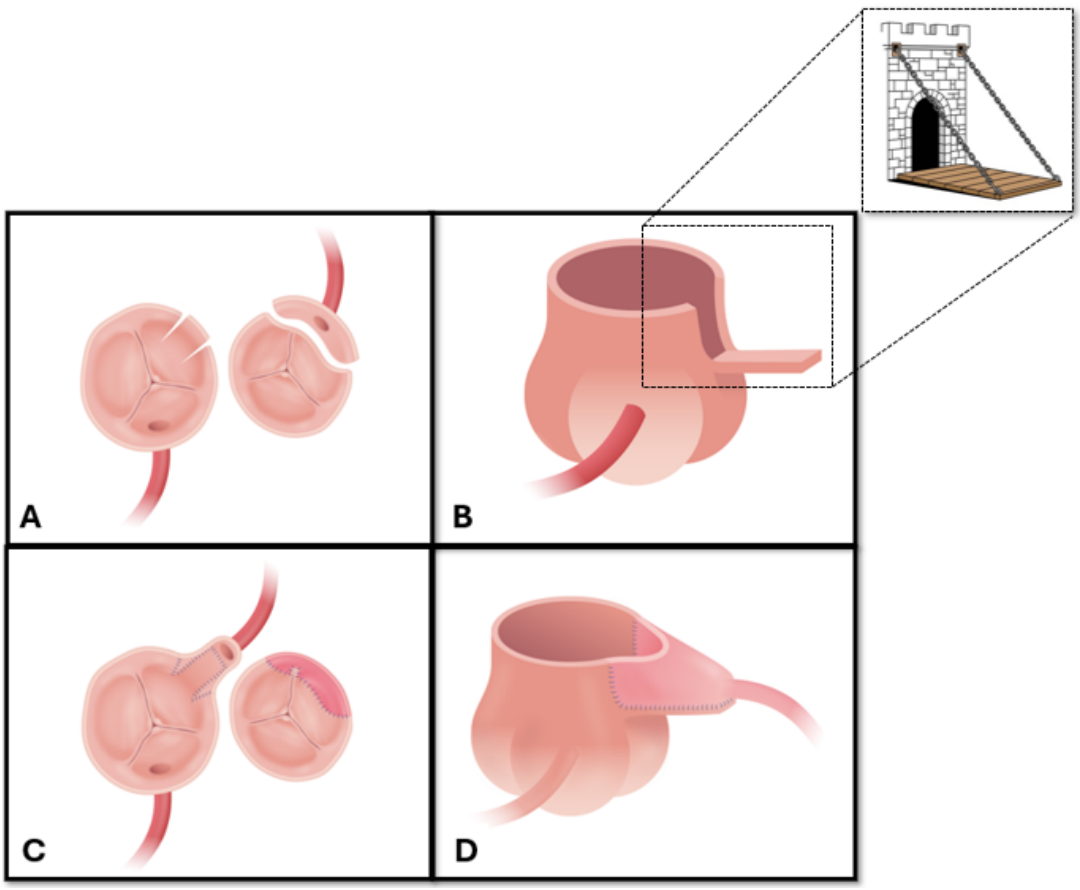

Figure 1. Aswan Drawbridge technique for ALCAPA from non-facing sinus. (A) Transection of the ascending aorta and harvesting of the coronary button. **(B)** Creation of an aortic flap in the left coronary sinus, reflected inferiorly as the tunnel floor in a Drawbridge like manner. **(C)** Suturing of the coronary button

side flaps to the aortic flap, forming an autologous tunnel; reconstruction of the MPA defect with an autologous pericardial patch and re-suspension of the pulmonary valve commissure. **(D)** Completed tension-free coronary reconstruction.

Results and follow-up

The postoperative course was uneventful, and the patient was discharged on postoperative day 7. Cardiac CT at 1 month showed a patent 5-mm left main tunnel, with normal size and course of the LAD and left circumflex (LCX) arteries and no kinking, stenosis, or compression (Figure 2B).

At 3 years, the patient remained asymptomatic, with unrestricted exercise tolerance. Annual transthoracic echocardiography showed a patent tunnel (4 mm in diameter), normal biventricular function, and no regional wall motion abnormalities. Mitral regurgitation regressed from moderate to mild, consistent with left ventricular reverse remodeling. The aortic valve was competent, and the pulmonary valve showed mild regurgitation with laminar forward flow.

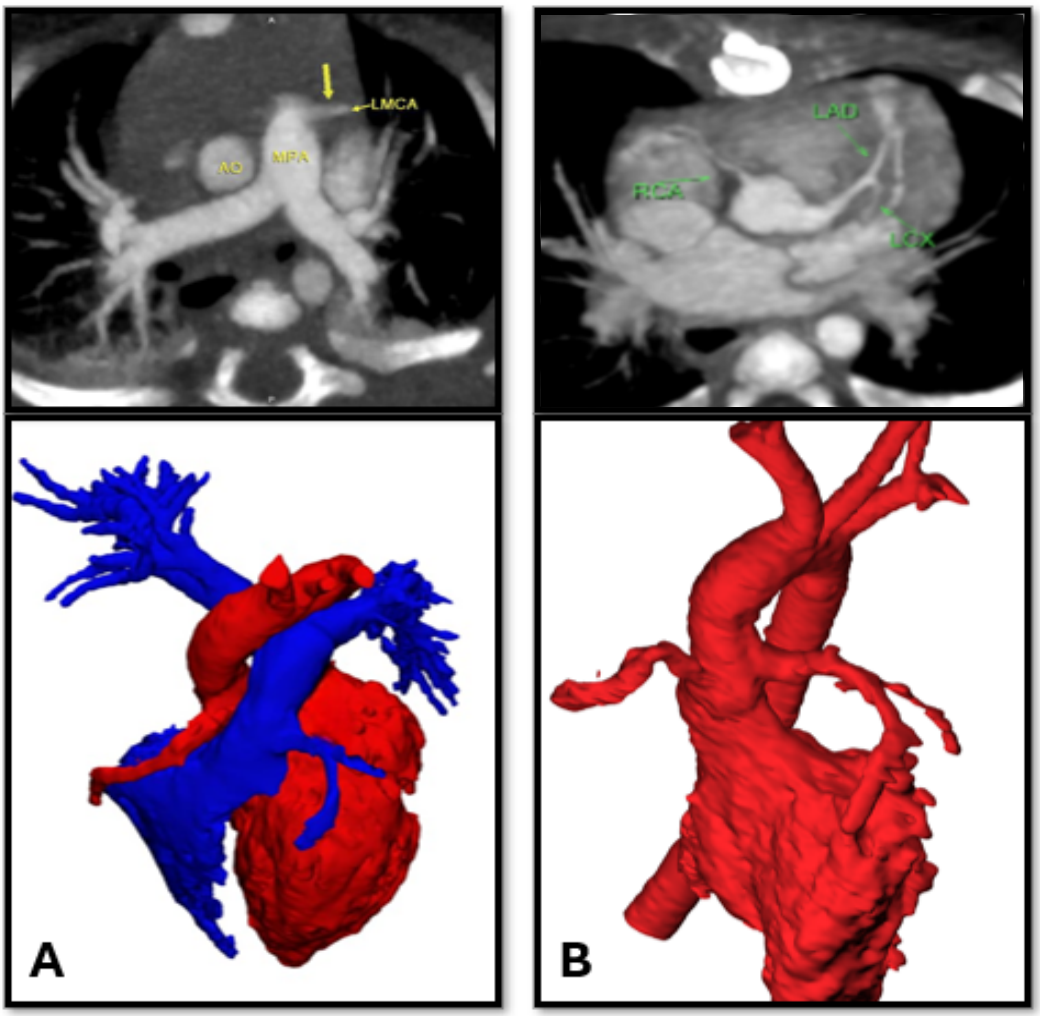

Figure 1. Preoperative and postoperative cardiac CT. (A) Preoperative CT showing the anomalous LCA originating from the non-facing sinus of the MPA, distant from the aortic root. **(B)** Postoperative CT demonstrating a widely patent LCA with no kinking, stenosis, or compression within the reconstructed autologous arterial tunnel.

Discussion

ALCAPA requires prompt surgical repair to prevent progressive myocardial ischemia and sudden cardiac death. Historical approaches included ligation of the anomalous LCA, saphenous vein grafting, and left subclavian artery–LCA anastomosis. Direct reimplantation is now the gold standard because it restores a physiological dual coronary system[1,3]. When the LCA arises from a facing pulmonary sinus, our standard technique is to create a medially hinged trapdoor flap in the aortic root and anastomose it to the coronary button. When the LCA arises from the distant non-facing sinus, however, reimplantation risks tension and occlusion of the transferred artery. The usual alternative, the Takeuchi procedure, has the drawbacks described above, and it is particularly difficult when a pulmonary valve commissure lies in the path of the intrapulmonary tunnel[3].

Our approach creates a tension-free tunnel of autologous arterial tissue from both aortic and pulmonary flaps. Partially detaching the pulmonary valve commissure maximized the size of the coronary button, which provided large flaps for the roof of the tunnel. A long aortic flap, reflected inferiorly like a drawbridge, formed the floor and reached the button without stretching the coronary artery. In this patient, the approach avoided tension on the transferred artery, and the tunnel was built entirely from autologous arterial tissue.

Other surgeons have also used autologous arterial flaps to bridge the gap between the coronary artery and the aorta. Turley et al.[6] created a coronary tunnel from anterior and posterior pulmonary artery wall flaps before anastomosing it to the aorta. Alsoufi and colleagues later reported excellent outcomes with this technique[3], supporting the use of autologous arterial reconstruction. Katsumata and Westaby[5] described another method of aortic implantation using autogenous arterial tissue. Unlike these approaches, in which the tunnel is built from pulmonary artery wall, the Drawbridge technique uses the aorta for the floor of the tunnel and the pulmonary artery for the roof.

Several strategies can restore a dual coronary system when the LCA arises far from the aorta. The best choice depends on the surgeon's experience, whether a tension-free reimplantation is anatomically achievable, and the likely complications of each option.

Limitations

This report describes a single patient with 3 years of follow-up, so the durability and reproducibility of the technique remain to be established. A specific concern is the ectatic appearance of the autologous arterial tunnel on early postoperative CT. We believe this reflects the initial geometry of the reconstruction rather than true pathological ectasia. Nevertheless, regular imaging is needed to distinguish favorable remodeling from progressive dilation. Echocardiography is limited for this purpose, so periodic cross-sectional imaging (CT or magnetic

resonance imaging) is advisable. The mild pulmonary regurgitation after commissural resuspension also warrants continued surveillance.

Conclusion

The Aswan Drawbridge technique is a feasible option for ALCAPA arising from the non-facing pulmonary sinus, particularly when the ostium lies close to a pulmonary valve commissure. Longer follow-up is needed to establish the durability of the tunnel.

Ethical approval and consent to publish

Written informed consent was obtained from the patient's parents for the publication of this case report, including all clinical details and accompanying images. Institutional Review Board (IRB) and ethical committee approval were not required due to the retrospective nature of this single case report.

Conflicts of interest

The authors declare that they have no conflicts of interest regarding the publication of this case report.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. Beasley GS, Stephens EH, Backer CL, Joong A. Anomalous Left Coronary Artery from the Pulmonary Artery (ALCAPA): a Systematic Review and Historical Perspective. *Curr Pediatr Rep. Springer Science and Business Media, LLC*. 2019;7(2):45-52. doi:10.1007/s40124-019-00191-8
2. Langen R, Cleuziou J, Krane M, et al. Long-term outcome after anomalous left coronary artery from the pulmonary artery repair: A 40-year single-centre experience. *European Journal of Cardio-thoracic Surgery*. 2018;53(4):732-739. doi:10.1093/ejcts/ezx407
3. Alsoufi B, Sallehuddin A, Bulbul Z, et al. Surgical Strategy to Establish a Dual-Coronary System for the Management of Anomalous Left Coronary Artery Origin From the Pulmonary Artery. *Annals of Thoracic Surgery*. 2008;86(1):170-176. doi:10.1016/j.athoracsur.2008.03.032
4. Takeuchi S, Imamura H, Katsumoto K, et al. New Surgical Method for Repair of Anomalous Left Coronary Artery from Pulmonary Artery. *J Thorac Cardiovasc Surg*. 1979;78(1):7-11
5. Katsumata T, Westaby S. *Anomalous Left Coronary Artery From the Pulmonary Artery: A Simple Method for Aortic Implantation With Autogenous Arterial Tissue*. Vol 68. 1999.
6. Turley K, Szarnicki RJ, Flachsbart KD, Richter RC, Popper RW, Tarnoff H. Aortic Implantation Is Possible in All Cases of Anomalous Origin of the Left Coronary Artery From the Pulmonary Artery. *Ann Thorac Surg*. 1995;60(1):84-89.