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Syncope as an Initial Presentation of Aorto-Left Ventricular Tunnel in Adulthood: A Report of a Rare Case

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Abstract

Aorto-left ventricular tunnel (AoLVT) is a rare congenital cardiac anomaly, usually diagnosed in childhood following the detection of a continuous murmur or symptoms of heart failure. Diagnosis in adulthood is uncommon, particularly when syncope is the first manifestation.

We report a 20-year-old man who presented with an unexplained syncopal episode. Physical examination revealed a continuous murmur along the left sternal border. Transthoracic echocardiography showed severe aortic regurgitation and an unusual cavity adjacent to the aortic root. Transesophageal echocardiography demonstrated an elongated anechoic cavity measuring 23.7 × 11.5 mm, closely related to the right and left coronary sinuses. Color Doppler revealed turbulent flow within the cavity, raising suspicion of abnormal communication between the aorta and the left ventricle. The aortic valve was tricuspid, with severe central regurgitation. The left ventricle was markedly dilated without hypertrophy (left ventricular end-diastolic diameter (LVEDD) 83 mm; left ventricular end-systolic diameter (LVESD) 66 mm), with an ejection fraction of 54%. Computed tomography (CT) angiography identified a type II AoLVT with aneurysmal dilatation of its extracardiac segment and defined its relationship with the coronary ostia. During surgery, the ventricular and aortic openings of the tunnel were closed with pericardial and Dacron patches, respectively. The right coronary cusp of the aortic valve was severely deformed and unsuitable for repair, requiring mechanical valve replacement. The postoperative course was uneventful. At 12 months, the patient remained asymptomatic, with signs of reverse remodeling of the left ventricle and satisfactory functioning of the prosthetic valve.

AoLVT should be considered in young adults presenting with unexplained syncope and aortic regurgitation. Successful management relies on a careful anatomical assessment and the appropriate surgical approach, followed by long-term monitoring.

Categories: Cardiology, Cardiac/Thoracic/Vascular Surgery, Anesthesiology
Keywords: adulthood, aortic regurgitation, aortic valve replacement, aorto-left ventricular tunnel, case report, syncope

Introduction

Aorto-left ventricular tunnel (AoLVT) is a rare congenital cardiac malformation, estimated to account for less than 0.1% of congenital heart defects [1]. Described in detail by Levy et al. in 1963, it consists of an extracardiac channel connecting the ascending aorta to the left ventricle while bypassing the aortic valve [2]. Blood flow through the tunnel occurs predominantly during diastole, producing chronic left ventricular volume overload. Over time, this may lead to progressive dilation of the left ventricle and heart failure, while associated distortion of the aortic cusps may contribute to aortic regurgitation [1,3,4].

According to the Hovaguimian classification, type II AoLVT is characterized by an aneurysmal extracardiac segment, typically associated with an oval-shaped aortic opening [5]. Most cases are diagnosed during childhood or adolescence, whereas diagnosis in adulthood remains uncommon [3,4]. In a systematic review of 177 reported cases, syncope was explicitly documented as the presenting symptom in only one patient [6]. We report a type II AoLVT diagnosed in a 20-year-old man after an unexplained syncopal episode, highlighting the importance of recognizing atypical presentations, the role of multimodality imaging in diagnosis and surgical planning, and the challenges of surgical repair in the presence of severe aortic valve involvement.

Case Presentation

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A 20-year-old man presented to the emergency department following his first episode of syncope, which occurred suddenly during physical exertion in the presence of friends. The loss of consciousness was brief, although its exact duration was unknown. He reported no preceding chest pain, palpitations, dyspnea, or other prodromal symptoms. He had a six-pack-year smoking history, with no significant medical history or previous episodes of presyncope. There was no family history of congenital heart disease or sudden cardiac death. On admission, blood pressure was 117/40 mmHg, heart rate was 83 beats per minute, oxygen saturation was 99% on room air, and temperature was 36.8°C. Physical examination revealed a grade 3/6 continuous murmur along the left sternal border without signs of heart failure.

Electrocardiography (ECG) showed sinus rhythm, left bundle branch block (QRS duration approximately 170 ms), and no ischemic changes. Continuous ECG monitoring during hospitalization did not reveal any arrhythmias. Chest radiography showed cardiomegaly with a cardiothoracic ratio of 0.55 and alveolar-interstitial opacities consistent with pulmonary congestion. Initial transthoracic echocardiography revealed severe aortic regurgitation (vena contracta width of 6 mm, effective regurgitant orifice area of 35 mm^2, regurgitant volume of 65 mL, and pressure half-time of 200 ms) associated with an unusual cystic-appearing structure adjacent to the aortic root, prompting further evaluation with transesophageal echocardiography (TEE). The latter demonstrated a well-defined, elongated anechoic cavity measuring approximately 23.7 × 11.5 mm (Figure *1*). On the mid-esophageal long-axis and modified short-axis views, the cavity appeared to extend beyond the aortic valvular apparatus, suggesting an extravalvular location (Figures *1*, *2*).

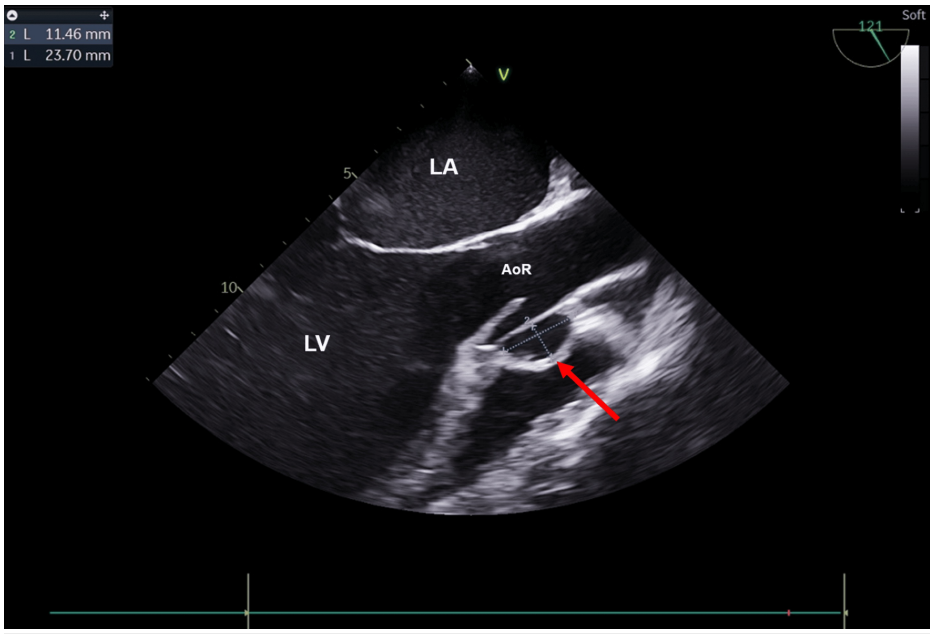


FIGURE 1: Mid-esophageal long-axis view

Transesophageal echocardiography showing an elongated anechoic cavity (23.7 × 11.5 mm) adjacent to the aortic root (red arrow).

LA: left atrium; AoR: aortic root; LV: left ventricle.

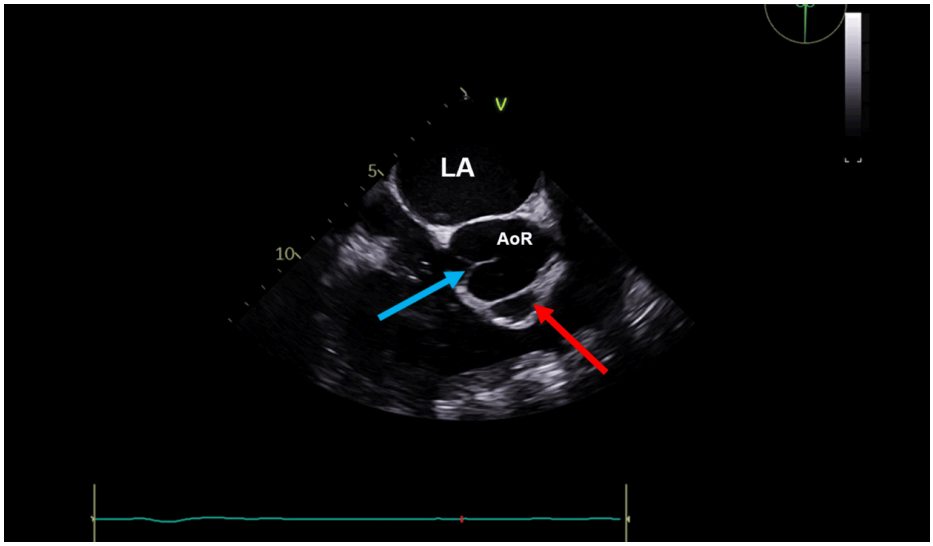
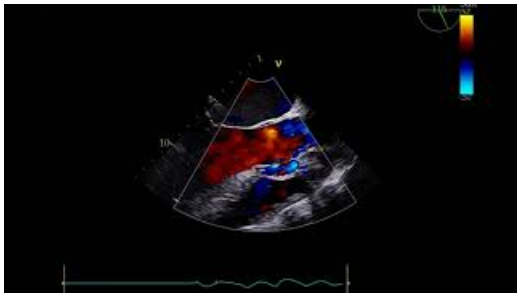


FIGURE 2: Modified mid-esophageal short-axis view

Transesophageal echocardiography shows the aortic valve (blue arrow) and the adjacent aorto-left ventricular tunnel (red arrow).

LA: left atrium; AoR: aortic root.

Color Doppler imaging revealed turbulent flow with aliasing within the cavity, raising suspicion of abnormal communication between the aortic root and the left ventricle (Video *1*).

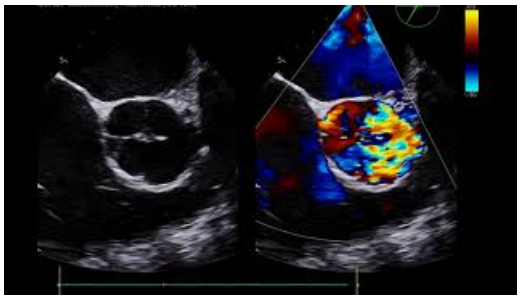


VIDEO 1: Mid-esophageal long-axis view with color Doppler

Transesophageal echocardiography shows turbulent flow with aliasing within the cavity, suggesting an abnormal aorto-left ventricular communication.

View video here: https://youtu.be/hp4BKw9KIxc?si=hE6R8qDGFbSHFRvY

Short-axis imaging further demonstrated its close anatomical relationship with the right and left coronary sinuses and the coronary ostial regions (Video *2*).



VIDEO 2: Mid-esophageal short-axis view

Transesophageal echocardiography shows the cavity adjacent to the right and left coronary sinuses.

View video here: https://youtu.be/Q0hY3BcF_cI?si=vidBrwziHnzpAfMQ

The aortic valve was tricuspid, with severe eccentric regurgitation. The left ventricle was markedly dilated without hypertrophy, with a left ventricular end-diastolic diameter (LVEDD) of 83 mm and a left ventricular end-systolic diameter (LVESD) of 66 mm, and a left ventricular ejection fraction (LVEF) of 54%. As the complete anatomical course and connections of the abnormal cavity could not be clearly delineated by echocardiography, computed tomography (CT) angiography was subsequently performed for further anatomical assessment.

Cardiac CT angiography revealed an extracardiac channel originating from the ascending aorta near the commissure between the right and left coronary sinuses and running posteriorly and inferiorly to open into the left ventricular outflow tract (LVOT) (Figure *3A*). The aortic portion of the channel exhibited focal aneurysmal dilation, while the coronary ostia appeared normal (Figure *3B*).

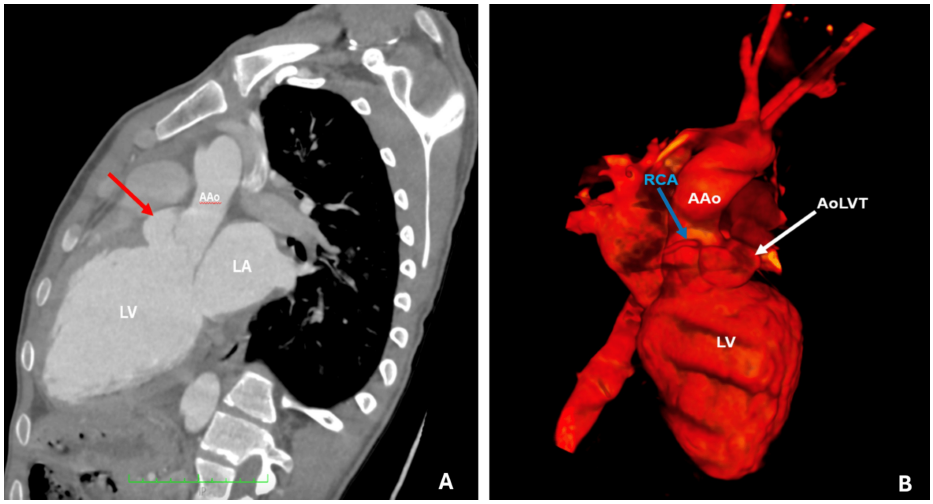


FIGURE 3: Cardiac computed tomography angiography

(A) Sagittal reconstruction showing the aorto-left ventricular tunnel (red arrow) and its relationship to the ascending aorta and left ventricle.

(B) Three-dimensional reconstruction showing the aneurysmally dilated extracardiac tunnel (white arrow) in close proximity to the right coronary artery (blue arrow).

LA: left atrium; LV: left ventricle; AAo: ascending aorta; AoLVT: aorto-left ventricular tunnel; RCA: right coronary artery.

Altogether, these imaging characteristics were consistent with a type II AoLVT. Preoperative laboratory tests were within normal limits (Table *1*).

Parameter	Patient value	Reference range
Hemoglobin	13.7 g/dL	13.0–16.0 g/dL
White blood cell count	7.3 × 10^3/μL	4.0–10.0 × 10^3/μL
Platelet count	175 × 10^3/μL	150–450 × 10^3/μL
C-reactive protein	5 mg/L	<5 mg/L
Serum urea	5.83 mmol/L	3.00–9.16 mmol/L
Creatinine	69.8 μmol/L	63.7–110.5 μmol/L
Troponin I	20 ng/L	<34.2 ng/L
Sodium	141 mmol/L	136–145 mmol/L
Potassium	3.7 mmol/L	3.5–5.0 mmol/L
Prothrombin activity	100%	70–100%

TABLE 1: Laboratory findings on admission

The patient received diuretic therapy for pulmonary congestion and underwent surgery seven days after admission.

Anesthesia was induced with careful titration of anesthetic agents to maintain hemodynamic stability, avoid bradycardia, and prevent excessive increases in systemic vascular resistance in the setting of severe aortic regurgitation. Invasive arterial pressure monitoring and central venous access were established. Intraoperative TEE was performed to assess ventricular function and evaluate the surgical repair.

The operation was performed through a median sternotomy followed by a longitudinal pericardiotomy. Cardiopulmonary bypass (CPB) was established via aortic and atriocaval cannulation. The ascending aorta was cross-clamped, and cardiac arrest was achieved using cold blood cardioplegia administered antegradely through direct coronary ostial perfusion, with a second dose delivered during the cross-clamp period. After performing a transverse aortotomy, careful inspection revealed the aortic orifice of the tunnel located above the commissure between the right and left coronary sinuses (Figure *4*).

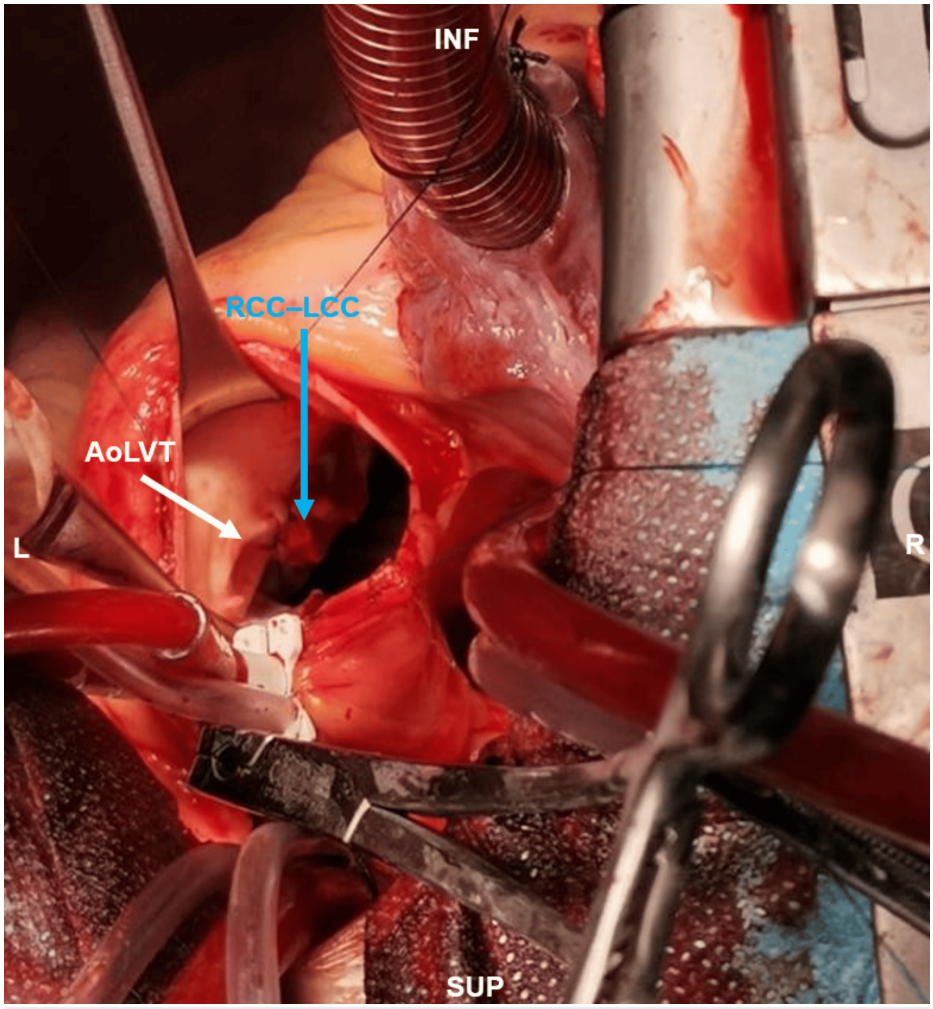


FIGURE 4: Intraoperative view after transverse aortotomy

The aortic opening of the AoLVT is identified by the white arrow, just above the RCC-LCC (blue arrow).

AoLVT: aorto-left ventricular tunnel; RCC-LCC: commissure between the right and left coronary cusps; L: left; R: right; SUP: superior; INF: inferior.

However, the right coronary cusp of the aortic valve was found to be severely deformed, which had not been identified on preoperative echocardiography. Given this finding, aortic valve replacement was deemed necessary. Following excision of the aortic valve, the ventricular orifice of the tunnel was identified at the nadir of the right cusp and closed using a glutaraldehyde-treated autologous pericardial patch, secured with continuous 5-0 polypropylene sutures, ensuring no obstruction to the left ventricular outflow tract. Subsequently, the aortic orifice of the tunnel was closed with a tailored polyethylene terephthalate (Dacron) patch using continuous 5-0 polypropylene sutures (Figure *5*). Closure of both orifices allowed complete exclusion of the aneurysmal extracardiac segment, which was left in situ without resection or plication.

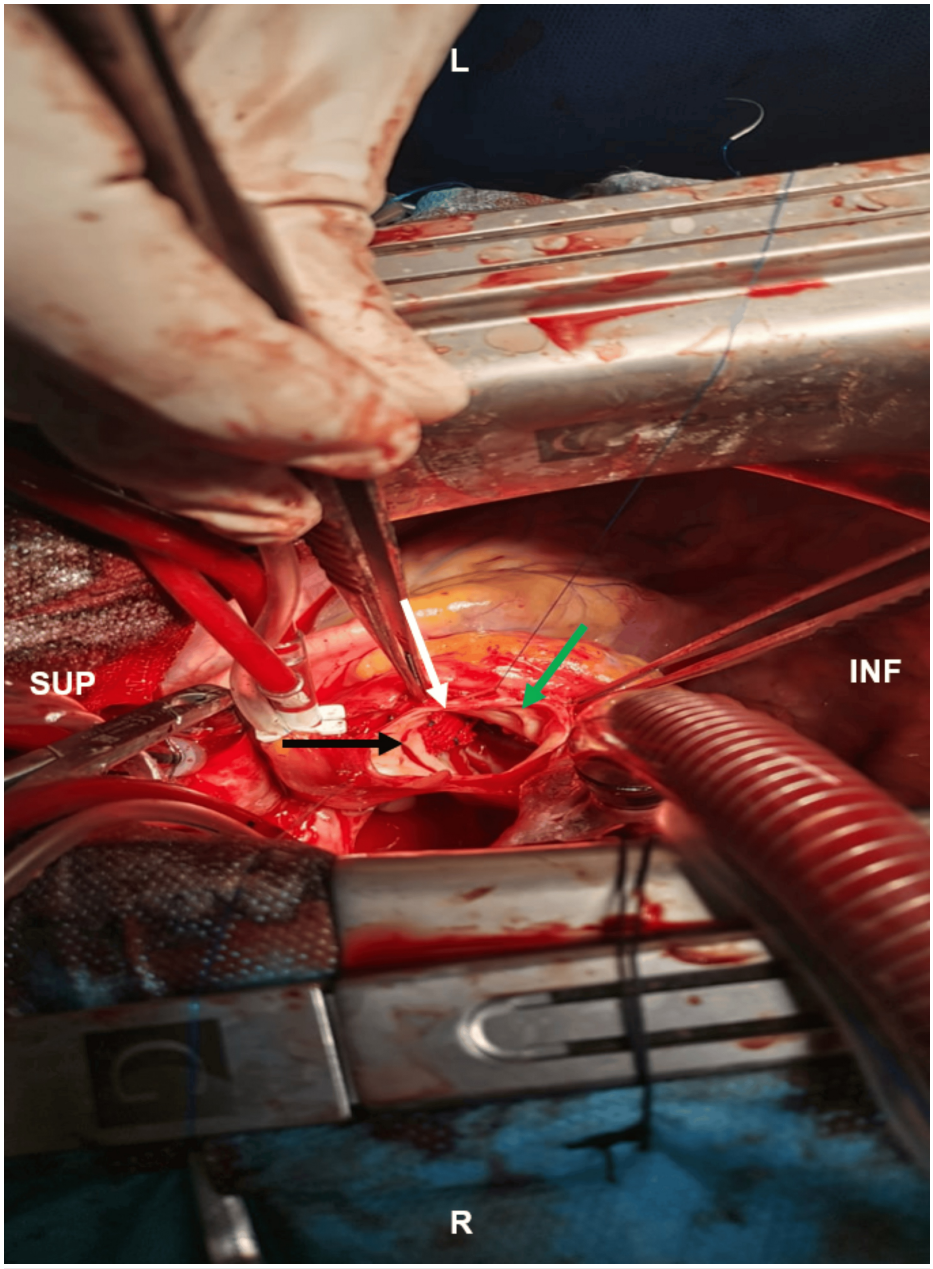


FIGURE 5: Intraoperative view following closure of the aortic opening of the aorto-left ventricular tunnel

The white arrow indicates the Dacron patch, the black arrow identifies the right coronary ostium, and the green arrow indicates the left main coronary ostium. L: left; R: right; SUP: superior; INF: inferior.

A mechanical bileaflet aortic valve prosthesis (23 mm, Bicarbon Slimline, LivaNova PLC, London, UK) was then implanted using interrupted, pledgeted 2-0 siliconized braided polyester sutures. Finally, the aortotomy was closed with continuous 5-0 polypropylene sutures in the usual fashion. Intraoperative TEE at separation from CPB confirmed complete tunnel exclusion, no residual shunt, and normal prosthetic valve function. The aortic cross-clamp time was 70 minutes, and the total CPB time was 90 minutes.

Postoperative recovery was uneventful. The patient was extubated four hours after surgery and discharged on postoperative day 7 under lifelong anticoagulation. At 12-month follow-up, he remained asymptomatic with normal exercise tolerance. Transthoracic echocardiography showed favorable left ventricular reverse remodeling, with a reduction in LVEDD from 83 to 55 mm and LVESD from 66 to 45 mm, a preserved LVEF (60%), no residual shunt, and excellent performance of the prosthetic valve without paravalvular leak.

Discussion

The AoLVT is usually diagnosed during infancy or early childhood, although some cases are not recognized until adulthood [1,3,4]. The tunnel creates an extracardiac connection that bypasses the aortic valve, allowing blood to flow from the aorta to the left ventricle, mainly during diastole. The resulting chronic volume overload can lead to significant left ventricular dilation, while associated abnormalities of the aortic cusps may contribute to progressive aortic regurgitation [1,3,4,7], as seen in our patient.

Syncope was the first symptom that led our patient to seek medical attention, which is unusual compared to the murmurs and heart failure symptoms more commonly reported in the literature [1,3,4]. Although coronary compression by an aneurysmal AoLVT has been reported as a cause of myocardial ischemia [8], no clinical or biochemical evidence of acute myocardial ischemia was identified in our patient. The mechanism of syncope remains uncertain, and a direct causal relationship with AoLVT cannot be established. A transient arrhythmia, particularly in the presence of left bundle branch block, or a hemodynamic disturbance associated with severe aortic regurgitation and marked left ventricular dilatation cannot be excluded. Although continuous in-hospital ECG monitoring revealed no arrhythmia, prolonged ambulatory rhythm monitoring and electrophysiological evaluation were not performed.

Diagnosing AoLVT can be challenging, particularly in adults, because several cardiac anomalies may produce similar clinical and echocardiographic findings. The main differential diagnoses include ruptured sinus of Valsalva aneurysm, coronary artery fistula, ventricular septal defect associated with aortic regurgitation, and patent ductus arteriosus [1,8,9]. Echocardiography is usually the first imaging modality to suggest the diagnosis, allowing assessment of the abnormal communication and its flow characteristics [1,9]. However, the entire course of the tunnel may not always be clearly visualized. In equivocal cases, multimodality imaging, including cardiac CT and MRI, is crucial to confirm the diagnosis and to delineate the extracardiac course of the tunnel and its relationship to the coronary ostia, thereby guiding the surgical strategy [8,9,10]. In our patient, transesophageal echocardiography raised suspicion of AoLVT, while CT angiography confirmed the diagnosis, detailed its course, its aneurysmal anatomy, and its relationship with the coronary ostia, and guided surgical planning. Coronary anatomy deserves special attention because the tunnel can be close to the coronary ostia or be associated with congenital coronary artery anomalies [1,3,6,8]. In our patient, CT angiography identified the origins of the two coronary ostia and their relationship with the tunnel; this provided enough anatomical information for surgical planning without the need for coronary angiography. Although the aneurysmal tunnel was in close proximity to the right coronary artery, no clinical or biochemical evidence of acute myocardial ischemia was identified.

Surgical closure remains the treatment of choice for AoLVT even in asymptomatic patients, to prevent progressive dilation of the left ventricle and damage to the aortic valve [1,3,4]. Several surgical techniques have been described, including direct suture or patch closure of the aortic opening alone, as well as closure of both the aortic and ventricular openings. Although isolated closure of the aortic opening with a patch remains the most commonly reported approach [3,4], closing both openings with patches can still be appropriate in some cases, especially for aneurysmal tunnels. This strategy has been advocated to reduce the risk of recurrence and postoperative aortic regurgitation while allowing tension-free repair and limiting aortic valve distortion [1,8,11]. In our patient, both openings were closed using an autologous pericardial patch at the ventricular end and a tailored Dacron patch at the aortic end. The aneurysmal segment was left in situ but completely excluded from the circulation by closure of both openings, with no residual flow detected on intraoperative transesophageal echocardiography.

Management of the aortic valve represents a critical aspect of AoLVT repair. Whenever feasible, valve-sparing procedures or cusp plasties should be attempted to preserve native valve function, especially in younger patients. Preservation of the native valve avoids the need for lifelong anticoagulation and reduces the risk of prosthesis-related complications. However, when cusp deformation or destruction is advanced, as in our case, valve replacement remains the only safe and definitive option [3,4]. Alternative approaches, such as percutaneous closure, have been described in highly selected cases with suitable anatomy [6,10]. Nevertheless, their role remains limited compared with surgery, particularly in the presence of aortic valve involvement or complex tunnel morphology. A recent series highlighted the progressive adoption of transcatheter techniques in specialized centers, though long-term outcomes are still under evaluation [6,10]. This case also highlights the importance of multidisciplinary collaboration between cardiac surgeons, anesthesiologists, and cardiologists, with intraoperative transesophageal echocardiography playing a key role in confirming complete tunnel exclusion and assessing prosthetic valve function.

Outcomes after surgical repair of AoLVT are generally favorable [3,4]. Contemporary cohorts have reported a meaningful incidence of late aortic regurgitation, ascending aortic dilatation, and, in rare cases, tunnel recurrence [6,12]. Lifelong surveillance with regular echocardiographic evaluation and periodic cross-sectional imaging is therefore mandatory to detect potential late complications [6,12]. In our patient, the outcome was very favorable at one year, although longer follow-up is needed to assess the durability of the repair.

This case report has certain limitations. The relatively short follow-up period of 12 months does not allow assessment of the long-term durability of the repair. Furthermore, although continuous in-hospital ECG monitoring revealed no arrhythmia, the absence of prolonged ambulatory rhythm monitoring or electrophysiological evaluation limits our ability to determine the precise mechanism of syncope.

Conclusions

Aorto-left ventricular tunnel should be considered in young adults presenting with unexplained syncope and aortic regurgitation. Accurate multimodality imaging, careful assessment of coronary anatomy, and an appropriate surgical approach are essential for optimal outcomes. Lifelong follow-up is essential to detect and manage late complications.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Acquisition, analysis, or interpretation of data: Ayoub Abetti, Choukri Bahouh, Hajar El Ouartassi, Asmae Oulad Amar, Kaoutar Benjaout

Drafting of the manuscript: Ayoub Abetti, Choukri Bahouh, Hajar El Ouartassi, Asmae Oulad Amar, Kaoutar Benjaout

Critical review of the manuscript for important intellectual content: Ayoub Abetti, Choukri Bahouh, Hajar El Ouartassi, Asmae Oulad Amar, Kaoutar Benjaout

Supervision: Kaoutar Benjaout

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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