

Unroofing Technique for Anomalous Origin of the Left Coronary Artery from the Right Sinus of Valsalva: Report of a Case

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Abstract

Anomalous origin of the left coronary artery (AOLCA) from the right sinus of Valsalva constitutes a rare congenital coronary artery anomaly. Patients with an anomalous left main coronary artery face a significantly higher risk of sudden cardiac death compared to those with an anomalous right coronary artery. The anomalous coronary artery traversing between the ascending aorta and the pulmonary artery markedly heightens the risk of myocardial ischemia, arrhythmia, and sudden death. Symptomatic patients often exhibit a longer intramural course of the coronary artery, which may necessitate earlier intervention or influence the choice of surgical repair method. Surgical intervention is advocated for patients with this anomaly, even in the absence of symptoms. For anomalous aortic origin of a coronary artery from the opposite sinus of Valsalva with an intramural course, coronary unroofing is the preferred revascularization procedure. This report presents a case of AOLCA originating from the right sinus of Valsalva, treated surgically using the unroofing technique for the aortic intramural segment of the anomalous coronary artery traversing between the great vessels. The unroofing technique is recommended for treating AOLCA with an extensive intramural course that does not involve the commissure.

Keywords

Unroofing Technique, Anomaly of Coronary Artery, Anomalous Origin of Left Coronary Artery

1. Introduction

Coronary artery anomalies are identified in approximately 0.24% of patients

undergoing coronary angiography [1]. While the majority of these anomalies are benign and asymptomatic, a minority can result in life-threatening myocardial ischemia, arrhythmia, and sudden death. Kaushal *et al.* reported that symptomatic patients often have a longer intramural course of the coronary artery, which may necessitate earlier intervention or influence the choice of surgical repair [2]. The optimal timing of surgery in asymptomatic patients remains controversial, requiring a careful balance between the risk of sudden cardiac death and the potential risks and long-term complications of surgical intervention. Patients with an anomalous left main coronary artery face a substantially higher risk of sudden cardiac death compared to those with an anomalous right coronary artery [3]. Anomalous origin of the left coronary artery (AOLCA) traversing between the great vessels is reported in 0.03% of cases [4], with the interarterial AOLCA associated with an elevated risk of myocardial ischemia and sudden cardiac death [5] [6] [7]. In the present case, the AOLCA originating from the right aortic sinus passed between the ascending aorta and the pulmonary artery, proceeding intramurally through the wall of the ascending aorta. For anomalous aortic origin of a coronary artery from an opposite sinus of Valsalva with an intramural course, coronary unroofing is the preferred surgical revascularization therapy [8]. This report discusses a case treated with the unroofing technique for the intramural segment of the anomalous coronary artery.

2. Case Report

A 56-year-old female patient, previously treated for hypertension with antihypertensive medication prescribed by her local physician, presented to our cardiology department with complaints of exertional chest pain and occasional rest pain. She had a history of heavy smoking but had ceased smoking ten years prior. Her blood pressure was 134/89 mmHg, and her pulse rate was 76 beats per minute. General blood test results were normal, and arterial blood gas analysis revealed a PO₂ of 71 mmHg on room air. A twelve-lead electrocardiogram showed a heart rate of 63 beats per minute, normal sinus rhythm, and no ischemic changes. A chest radiograph indicated no cardiac enlargement, with a cardiothoracic ratio of 0.45, and no pulmonary congestion. Echocardiography revealed normal wall motion with a left ventricular ejection fraction of 65%, and no other significant abnormalities. Suspecting exertional angina pectoris, we performed a Master double exercise stress electrocardiogram test, which showed no obvious signs of ischemia or significant arrhythmia. Computed tomography angiography (CTA) demonstrated that the left coronary artery originated from the right sinus of Valsalva (**Figure 1**). The main trunk of the left coronary artery, slightly compressed, passed between the ascending aorta and the pulmonary artery, proceeding intramurally through the wall of the ascending aorta. The CTA examination revealed no significant coronary stenotic lesions aside from the main trunk of the left coronary artery. Coronary catheterization was omitted as the clear CTA ruled out other significant stenotic lesions, and the patient de-

clined further investigation.

Informed consent was obtained from the patient for surgery. The operation was conducted with cardiopulmonary bypass under mild systemic hypothermia following a median sternotomy and aortocaval cannulation. The root of the ascending aorta was dissected, revealing no abnormal vessels around and between the great vessels. The ascending aorta was clamped, and cardiac arrest was induced by antegrade and retrograde cold blood cardioplegia. A transverse incision was made on the proximal wall of the ascending aorta to visualize the lumen of the aortic root. Two orifices were observed in the right sinus of Valsalva: a normal right coronary ostium and a small slit-like ostium of the left coronary artery. A pair of curved forceps was gently inserted into the ostium of the anomalous left coronary artery, and the common wall of the intramural coronary artery and the aorta was carefully incised with a round Beaver Mini-Blade microscalpel. Approximately 2 cm of the anomalous coronary artery was unroofed by excising the roof of the artery into a thin strip, creating a correct neo-ostium in the left sinus of Valsalva (**Figure 2**). Good blood flow from the neo-ostium was confirmed by retrograde cardioplegia infusion. Subsequently, antegrade cardioplegia was administered directly to the neo-ostium with satisfactory pressure and flow. The aortotomy was closed with horizontal mattress and continuous running sutures. The patient was smoothly weaned from cardiopulmonary bypass. The postoperative course was uneventful, and she was discharged on the 18th postoperative day. Postoperative CTA demonstrated a normal left coronary artery with the ostium in the left sinus of Valsalva without stenosis (**Figure 3**). Six months postoperatively, she remains asymptomatic and well. We have scheduled annual follow-up CTA examinations for at least the next five years. Informed consent for the reporting of this case was obtained from the patient, and the local ethical committee approved the case report.

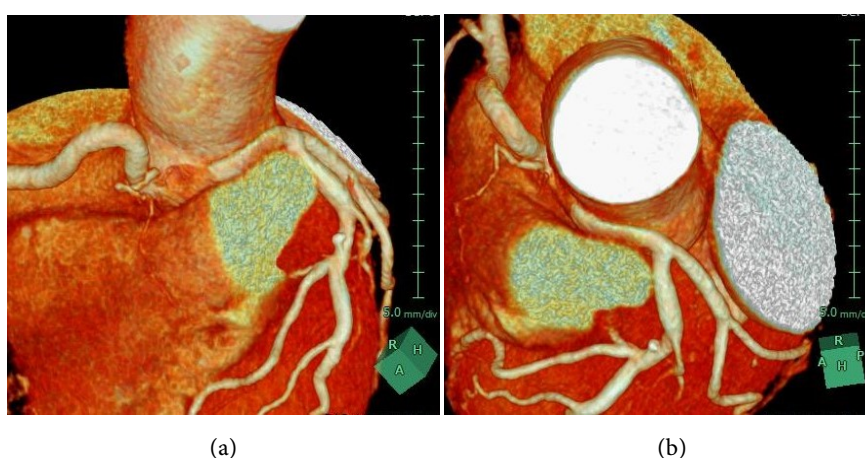


Figure 1. Preoperative computed tomography angiography (CTA) reveals that the left coronary artery originates from the right sinus of Valsalva (a). The main trunk of the left coronary artery, slightly compressed, traverses between the ascending aorta and the pulmonary artery, proceeding intramurally through the wall of the ascending aorta (b).

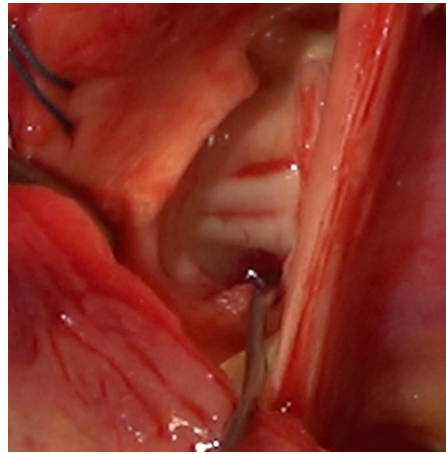


Figure 2. A correct neo-ostium of the left coronary artery is established in the left sinus of Valsalva after excising the roof of the anomalous coronary artery.

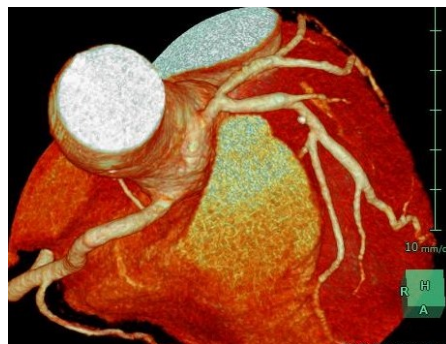


Figure 3. Postoperative computed tomography angiography (CTA) shows a normal left coronary artery with the ostium located in the left sinus of Valsalva, free of stenosis.

3. Discussion

Anomalous aortic origin of a coronary artery from an opposite sinus of Valsalva (ACAOS) presents with various clinical manifestations and anatomical variants [4]. Although most patients remain asymptomatic, potential symptoms include angina pectoris, chest pain, palpitations, dyspnea, dizziness, syncope, myocardial infarction, and sudden cardiac death [9]. Coronary CTA is an anatomical diagnostic tool that offers superior noninvasive spatial resolution and the ability to evaluate the entire course of the coronary arteries [4] [10] [11]. Symptomatic ACAOS often necessitates surgical repair and is frequently associated with a longer intramural course of the coronary artery, which may prompt earlier intervention or dictate the surgical approach [2]. The interarterial course is considered a driver of ischemia, due to a scissor-like compression of the coronary blood flow during exertion, caused by the close proximity of the anomalous segment to the aorta and pulmonary artery [5]. Moreover, the risk of sudden cardiac death is significantly higher in patients with an anomalous left main coronary artery compared to those with an anomalous right coronary artery [3]. In

the present case, the patient exhibited myocardial ischemic symptoms on exertion, with an anomalous left coronary artery having a long intramural course passing between major vessels, thus necessitating surgical intervention. Due to the risk of sudden death in such cases, surgical treatment is recommended even for asymptomatic patients [9].

Most institutions advocate conservative management with sports restriction and medical therapy for bridging patients with ACAOS until surgical treatment can be performed, or in cases where patients decline surgery or it is not feasible [12] [13] [14] [15] [16]. The evidence supporting the use of percutaneous coronary intervention (PCI) in ACAOS is limited, as PCI targets atherosclerotic lesions distal to the anomalous segment and does not address the anatomical anomaly itself [6]. Surgical revascularization remains the primary treatment strategy for patients with hemodynamically significant ACAOS [8] [17] [18]. Coronary unroofing is the most common surgical procedure for ACAOS with an intramural course [18]. This technique involves exploring and confirming the intramural course with a coronary probe, then sharply excising or incising the common wall with the aorta along the entire intramural course proximal to its emergence from the aortic wall [19] [20]. In the reported case, the intramural course was confirmed using curved forceps, and the common wall of the intramural coronary artery and the aorta was safely and accurately incised with a round Beaver Mini-Blade microscalpel, unroofing the anomalous artery into a thin strip. Tacking sutures can be placed to ensure intimal continuity and prevent dissection [3] [9] [18]. In this case, the roof of the intramural segment was successfully resected, creating smooth continuity between the left coronary artery ostium and the aortic intima, thus tacking sutures were deemed unnecessary. Coronary unroofing is appropriate for long intramural courses without commissural involvement. When the anomalous vessel traverses near or below the commissure, unroofing may impair aortic valve suspension [9], necessitating either commissural detachment or resuspension [21]. However, commissural manipulation carries a higher risk of postoperative aortic regurgitation [16]. Mery *et al.* noted that a long intramural segment is favorable for unroofing success, while a short intramural segment limits its effectiveness [12]. Hatoum *et al.* highlighted that this is particularly relevant when the anomalous vessel courses through a thickened commissure or pillar [22]. Razavi *et al.* [23] pointed out that a short intramural course often results in insufficient correction of the acute take-off angle post-unroofing, thus maintaining compromised coronary flow patterns. Alternative surgical options include coronary translocation and reimplantation, which are complex procedures involving extensive artery dissection and manipulation, with unknown long-term outcomes [9]. Coronary artery bypass grafting (CABG) poses a higher risk of failure due to competitive flow through the native anomalous segment, with a high graft failure rate reported [18] [24]-[30]. Proximal ligation of the anomalous coronary artery is crucial for CABG patency but results in complete dependence on the graft with uncertain

durability [9]. CABG should be reserved for patients with significant concomitant coronary artery disease within the anomalous vessel [9] [27] [31] [32].

4. Conclusion

We report a case of anomalous origin of the left coronary artery (AOLCA) from the right sinus of Valsalva, a rare congenital coronary anomaly, which was successfully treated with the unroofing technique for the aortic intramural segment of the anomalous artery passing between the great vessels. This procedure is indicated for patients with AOLCA with a long intramural course that does not involve the commissure. We plan to extend the follow-up period and provide comprehensive data on long-term outcomes and the durability of the surgical intervention.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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