

Left Anterior Descending Artery to Right Coronary Artery Bifurcation Stenting with Culotte Technique in Acute Inferior Myocardial Infarction

Akut Alt Duvar Miyokard Enfarktüsünde Sol Ön İnlen Koroner Arterden Sağ Koroner Artere Culotte Tekniği ile Bifurkasyon Stentleme İşlemi

ABSTRACT

Coronary artery anomalies are defined as abnormal origin, course, or termination of any of the three main epicardial coronary arteries. These anomalies are typically asymptomatic and are often discovered incidentally. However, certain anomalies may be associated with an increased risk of myocardial infarction, syncope, ventricular arrhythmias, and exercise-induced sudden cardiac death. A single coronary artery anomaly is a very rare form of coronary artery anomaly and typically supplies a large myocardial perfusion area. Here, we describe an extremely rare case of a single coronary artery anomaly in which the right coronary artery (RCA) originates from the mid-segment of the left anterior descending (LAD) coronary artery. The patient presented with acute inferior myocardial infarction and underwent LAD/RCA bifurcation stenting using the Culotte technique.

Keywords: Acute myocardial infarction, coronary artery anomaly, Culotte technique, left anterior descending artery/right coronary artery (LAD/RCA) bifurcation

ÖZET

Koroner arter anomalileri, üç ana epikardiyal koroner arterden herhangi birinin anormal kökeni, seyri ya da sonlanması olarak tanımlanır. Genellikle kardiyak şikâyetle neden olmazlar ve tesadüfen saptanırlar. Ancak bazı koroner arter anomalileri, miyokard enfarktüsü, bayılma, ventriküler aritmiler ve egzersize bağlı ani kardiyak ölüm riskinde artış ile ilişkili olabilirler. Koroner arter anomalileri içerisinde tek koroner arter anomalisi çok nadir görülür ve tek koroner arter, geniş miyokardiyal beslenme alanı sağlar. Biz burada, akut alt duvar miyokard enfarktüsü ile başvuran hastada sol ön inlen koroner arterden (LAD) çıkan sağ koroner arterin (RCA) olduğu tek koroner arter anomalisinde LAD/RCA bifurkasyon lezyonunun Culotte tekniği ile revaskülarize edildiği sıra dışı vakayı sunduk.

Anahtar Kelimeler: Akut miyokard enfarktüsü, koroner arter anomalisi, Culotte tekniği, sol ön inlen koroner arter/çıkan sağ koroner arter bifurkasyonu

Coronary artery anomalies are defined as any abnormality in the origin, course, or termination of the three main epicardial coronary arteries and may coexist with congenital heart disease. These anomalies are generally asymptomatic and are most often discovered incidentally during coronary angiography, computed tomography, or autopsy in individuals without congenital heart disease.^{1,2} However, certain anomalies have been associated with an increased risk of myocardial infarction, syncope, ventricular arrhythmias, and exercise-induced sudden cardiac death.²⁻⁴

Isolated coronary artery anomalies are observed in approximately 0.5% of patients undergoing coronary angiography and in 0.3% of autopsy series.¹⁻³ The most common coronary anomaly involves the left anterior descending (LAD) and left circumflex (Cx) arteries originating separately from the left main coronary artery (LMCA), accounting for roughly 35% of cases. Other frequent anomalies include the right coronary artery (RCA) originating from the left coronary sinus (22%) and the Cx artery arising from the right coronary artery (20%).³ A single coronary artery is another rare coronary anomaly, seen much less frequently, approximately 8% of all coronary anomalies.^{4,5}

CASE REPORT OLGU SUNUMU

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Here, we describe an extremely rare case documented in the literature, in which the RCA originates from the mid-segment of the LAD, as visualized on coronary angiography. The patient presented with an acute inferior myocardial infarction and was treated with LAD/RCA bifurcation stenting using the Culotte technique.

Case Report

A 69-year-old male presented with typical anginal chest pain for approximately 3–4 hours. He had no prior history of cardiac disease or other comorbidities. While in the emergency department, the patient suffered a sudden cardiac arrest, requiring cardiopulmonary resuscitation (CPR) for 10 minutes. Following successful stabilization of blood pressure and heart rhythm, electrocardiography revealed ST-segment elevation in leads D2, D3, and aVF, along with ST depression in the anterior leads (Figure 1A). The patient was intubated and remained hypotensive and tachycardic. After administration of acetylsalicylic acid (ASA) and clopidogrel via nasogastric tube, as well as intravenous heparin, the patient was taken for emergency coronary angiography. On coronary angiography, a 95% stenosis was observed in the mid-segment of the LAD, along with a subtotal thrombosed lesion in the distal Cx (Figure 1B). The RCA was not visualized initially, and the culprit lesion responsible for the myocardial infarction was presumed to be in the Cx artery. The lesion was predilated using a 2.5 × 15 mm balloon, followed by implantation of a 3.5 × 44 mm Supraflex stent (Sirolimus-Eluting Coronary Stent System, Sahajanand Medical Technologies Ltd.) (Figure 1C). Despite administration of intracoronary nitrate (100 mcg), ST-segment elevation persisted on the monitor, and the patient's chest pain response could not be assessed. Subsequently, the RCA originating from the mid-LAD region was identified using a 6-F Amplatz left 2 (AL2) guide catheter. The LAD-RCA bifurcation lesion was classified as Medina (1,0,1) (Figures 2A–B), and percutaneous coronary intervention (PCI) to the RCA was planned using the provisional technique (Video 1). Both the LAD and RCA

ABBREVIATIONS

AL2	Amplatz left 2
ASA	Acetylsalicylic acid
CABG	Coronary artery bypass grafting
Cx	Circumflex
EF	Ejection fraction
LAD	Left anterior descending
LMCA	Left main coronary artery
NC	Non-compliant
PCI	Percutaneous coronary intervention
POT	Proximal optimization technique
PTCA	Percutaneous transluminal coronary angioplasty
RCA	Right coronary artery

were wired (Figure 2B). The RCA was predilated using a 2.5 × 15 mm balloon, followed by implantation of a 3.0 × 32 mm Promus Premier™ Select stent (Everolimus-Eluting Coronary Stent System, Boston Scientific, USA) (Figure 2C). Kissing percutaneous transluminal coronary angioplasty (PTCA) was performed at the mid-LAD lesion using 2.75 × 15 mm and 4.0 × 12 mm non-compliant (NC) balloons for the RCA and LAD, respectively (Figure 2D). Following the kissing PTCA, it was decided to stent the LAD using the Culotte technique. After rewiring, a 3.5 × 32 mm Promus Premier™ Select stent (Everolimus-Eluting Coronary Stent System, Boston Scientific, USA) was implanted in the mid-LAD lesion (Figure 2E). A second kissing PTCA was then performed using 3.5 × 15 mm and 4.0 × 12 mm NC balloons for the LAD and RCA, respectively (Figure 2F). Proximal optimization technique (POT) was subsequently performed with a 4.0 × 12 mm NC balloon, achieving an optimal final result (Figures 2G–H, Video 2). The patient was extubated approximately two days later. Ejection fraction (EF) was measured at 40%, with evidence of inferior and posterior hypokinesia. He was discharged one week

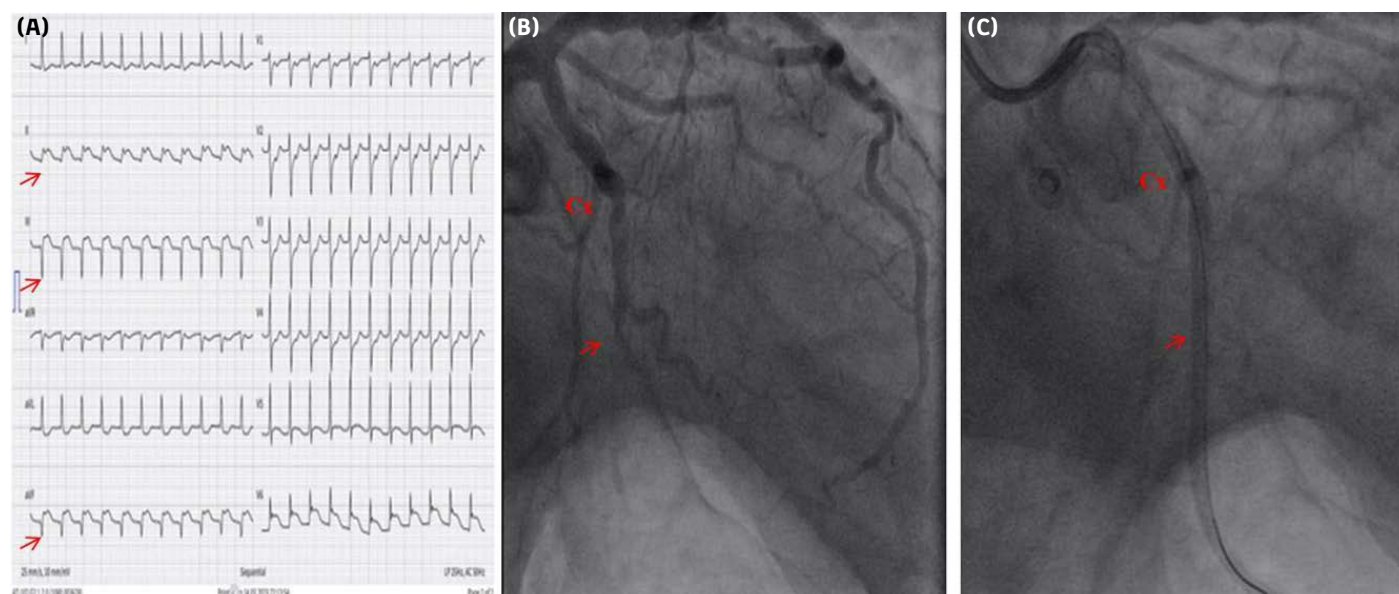


Figure 1. (A) Electrocardiogram showing ST-segment elevation in leads DII, DIII, and aVF, with ST-segment depression in leads V1–V3. (B) Coronary angiography showing a subtotal thrombosed lesion in the left circumflex (Cx) artery. (C) Coronary angiography showing the left circumflex (Cx) artery after stent implantation.

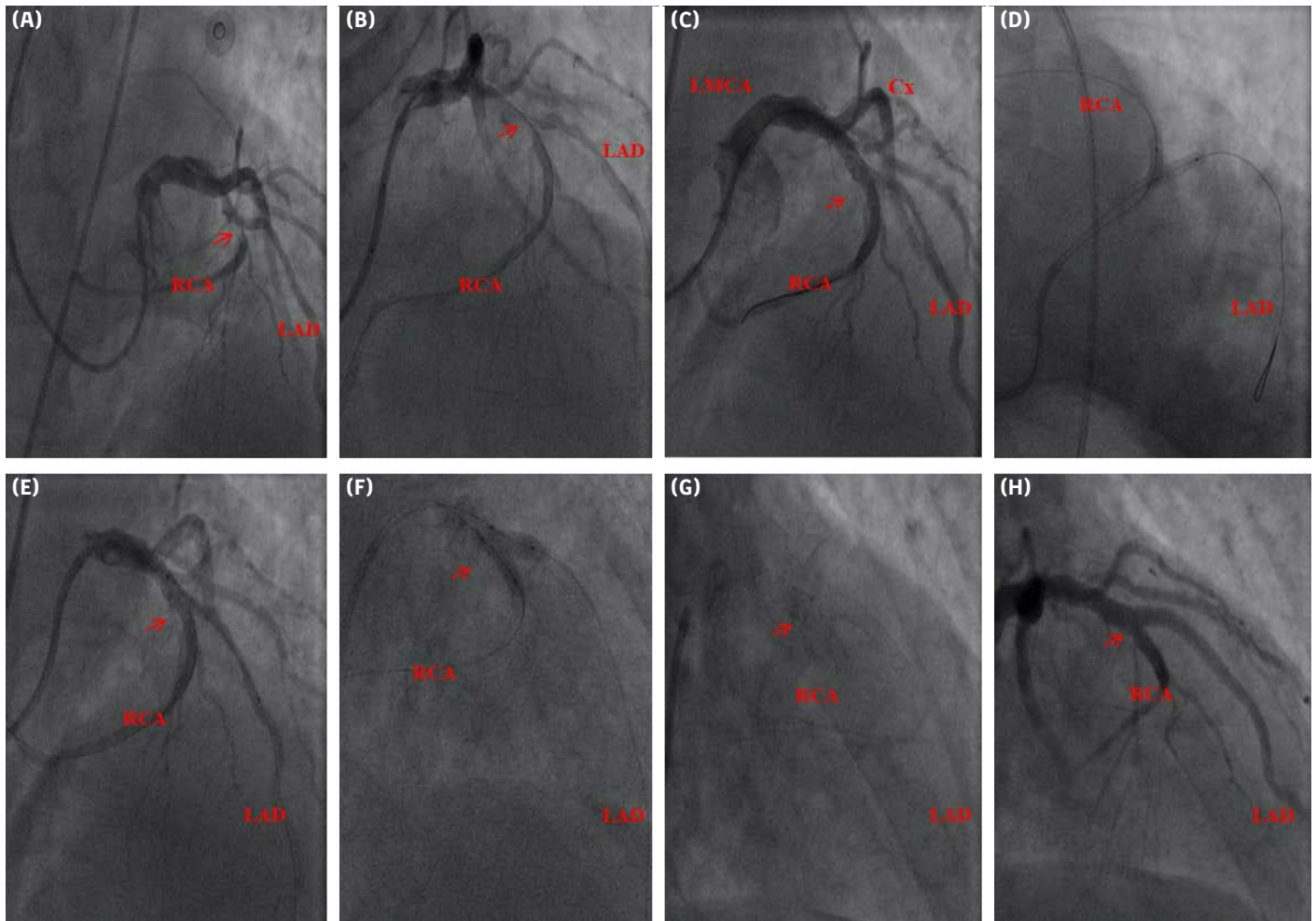


Figure 2. (A) Coronary angiographic imaging using a 6-French Amplatz Left 2 (AL2) guiding catheter, showing 95% stenosis at the ostium of the right coronary artery (RCA), which originates from the mid-left anterior descending (LAD) artery. (B) Coronary angiography showing both the right coronary artery (RCA) and left anterior descending (LAD) artery lesions wired. (C) Coronary angiographic imaging following implantation of a 3 × 32 mm stent into the right coronary artery (RCA). (D) Coronary angiographic imaging of the first kissing balloon procedure involving the left anterior descending (LAD) artery and the right coronary artery (RCA). (E) Coronary angiographic imaging showing implantation of a 3.5 × 32 mm stent into the left anterior descending (LAD) artery using the Culotte technique. (F) Coronary angiographic imaging of the second kissing balloon procedure involving the left anterior descending (LAD) artery and the right coronary artery (RCA). (G) Coronary angiographic non-contrast imaging showing implanted stents in the left anterior descending (LAD) artery and the right coronary artery (RCA) using the Culotte technique. (H) Coronary angiographic contrast imaging showing implanted stents in the left anterior descending (LAD) artery and the right coronary artery (RCA) using the Culotte technique.

later on acetylsalicylic acid, clopidogrel, bisoprolol, perindopril, spironolactone, and atorvastatin. The patient provided written informed consent for publication of this case.

Discussion

Our case represents an exceptionally rare single coronary artery anomaly, in which stenting was performed from LAD to the RCA using the Culotte technique. A single coronary artery anomaly is a rare congenital coronary abnormality, in which a single coronary artery arises from the aorta or provides perfusion to the entire myocardium.^{6,7}

Coronary artery anomalies may occur in isolation or in association with other congenital cardiac defects, such as transposition of the great vessels, bicuspid aortic valve, tetralogy of Fallot, or

arteriovenous fistulae.^{2,7} In the largest angiographic series reported in the literature, comprising 126,595 cases, Yamanaka et al.² identified a 1.3% prevalence of isolated coronary artery anomalies. Among these, 225 cases were identified as coronary artery fistulae, and 1,461 cases involved abnormalities in the origin or course of the coronary arteries. Single coronary artery anomaly was found to be extremely rare, with a reported incidence of 0.05%. Although often asymptomatic, single coronary artery anomalies can present with chest pain, dyspnea, palpitations, syncope, myocardial infarction, ventricular fibrillation, and even sudden cardiac death. In one study, the incidence of coronary artery anomalies was reported to be as high as 12–19% among individuals who experienced sudden death at a young age.^{8,9} These anomalies may also alter myocardial perfusion and predispose to atherosclerosis by reducing

the vasodilatory response.^{10,11} When atherosclerotic stenosis is detected, treatment options include medical management, PCI, or surgical intervention. PCI in such cases presents several challenges, including limited guiding catheter support, the need for specialized equipment, selection of the appropriate PCI strategy, and the necessity for an experienced operator.¹²⁻¹⁵

In the literature, there are very few reported cases of an anomalous RCA originating from the mid-LAD, and no standardized revascularization strategy has been established due to the anatomical complexity of these cases. In some instances, coronary artery bypass grafting (CABG) has been used for revascularization, while in others, PCI has been successfully performed depending on the operator's expertise.¹¹⁻¹⁵ In the case reported by Calabrò et al.,¹³ provisional LAD bifurcation stenting was performed for a 90% stenosis in the mid-LAD adjacent to the origin of the anomalous RCA. In reviewing other rare cases in the literature, Prasad et al.¹⁴ used the reverse crush technique, and Khan et al.¹⁵ employed the Culotte technique for treating mid-LAD/RCA lesions in two non-ST-segment elevation myocardial infarction (non-STEMI) patients. Considering that a single coronary artery supplies most of the myocardial territory, any complication can significantly affect a large portion of the myocardium. Therefore, such anomalies have been described in the literature as similar to unprotected left main coronary artery lesions.¹³⁻¹⁵ In these cases, unlike conventional catheterization procedures, several challenges may arise, including the need for adequate catheter support, precise cannulation, appropriate imaging during PCI, selecting a less commonly used catheter, providing the optimal curvature to the guidewire, and difficulty advancing balloons or stents.^{14,15} For optimal catheter support, the use of a wide-angle AL2 catheter may be more effective, as demonstrated in our case. Initially, we were unable to visualize the RCA due to insufficient contrast filling using a JL4 catheter. If the coronary arteries are excessively tortuous, a hydrophilic wire may be required to reduce the risk of perforation. Additionally, intravascular imaging may be necessary in areas with overlapping stents.^{14,15} In our case, intravascular imaging was not utilized due to the lack of hemodynamic stability. However, in stable patients, intravascular imaging can be considered in bifurcation lesions to help prevent incomplete or suboptimal PCI. Initially, provisional stenting from the LAD to the RCA was planned. However, following the kissing balloon procedure, the LAD lesion was reassessed as significant. The strategy was subsequently changed to the Culotte technique, taking into account the similarity in vessel diameters and the favorable vessel angle.

Conclusion

In conclusion, our case highlights a rare single coronary artery anomaly in which the RCA originated from the mid-LAD, presenting as an acute inferior myocardial infarction, and successfully treated with LAD/RCA bifurcation stenting using the Culotte technique. A single coronary artery anomaly is a very rare congenital coronary condition that supplies a large myocardial perfusion area. Treating such cases presents certain challenges, including determining the optimal revascularization technique, selecting appropriate equipment, and requiring an experienced operator. Our case is unusual in that complex and complete revascularization was successfully performed in the setting of a rare single coronary artery anomaly.

Ethics Committee Approval: This is a single case report, and therefore ethics committee approval was not required in accordance with institutional policies.

Informed Consent: The patient provided written informed consent for publication of this case.

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Video 1. Angiographic imaging showing significant stenosis at the ostium of the right coronary artery, originating from the mid-left anterior descending (LAD) artery.

Video 2. Angiographic imaging showing the implanted stents in the left anterior descending (LAD) artery and the right coronary artery (RCA) using the Culotte technique.

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