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Interventional Management of Chronic Total Occlusion in the Left Main Coronary Artery

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Abstract

Chronic total occlusion (CTO) of the left main coronary artery (LMCA) is a rare finding on angiograms, with coronary artery bypass grafting typically considered the standard approach for revascularization.

To highlight the potential viability of percutaneous coronary intervention (PCI) as a safe alternative in select cases, we present a complex clinical case involving the revascularization of chronic total occlusions in the LMCA, left anterior descending artery (LAD), and circumflex artery (CX).

Methods: Recanalization of the occluded LMCA and LAD was achieved using a support-balloon technique and CTO wires (Miracle 3™ wire, Abbott Vascular; Runthrough® NS Intermediate wire, Terumo). Stenting was performed in the LAD, CX, LMCA, and its bifurcation using three drug-eluting stents (Resolute Integrity DES, Medtronic). Bifurcation stenting utilized the "Culotte Stenting" technique, followed by "Kissing Balloon" post-dilatation. Proximal optimization technique was applied in the LMCA.

Results: The intervention concluded without complications. Two months post-stenting, the patient experienced an increase in ejection fraction from 20% to 38% and improvement in various cardiac parameters, resulting in a decrease in Congestive Heart Failure functional class to class I.

Conclusions: This case underscores the potential for successful revascularization of LMCA CTO lesions through PCI, provided appropriate patient selection and procedural techniques are employed.

Keywords: Chronic Total Occlusion (CTO); Left Main Coronary Artery (LMCA) Disease; Coronary Disease.

Introduction

According to the World Health Organization, cardiovascular diseases (CVDs) claimed the lives of 17.7 million individuals in 2015, with 75% of these fatalities occurring in developing and low-income countries. Presently, CVDs are responsible for approximately 17.9 million deaths annually, constituting an estimated 31% of all global deaths. These diseases, encompassing coronary, cerebrovascular, and peripheral artery conditions, as well as congenital and rheumatic heart diseases, deep vein thrombosis, and pulmonary thromboembolism, stand as the leading cause of mortality worldwide [1].

Chronic total occlusion (CTO) of coronary arteries is encountered in 15 to 20% of patients undergoing coronary angiography (CAG). Particularly, chronic total occlusion of the left main coronary artery (LMCA) is a rare angiographic finding characterized by a complete absence of antegrade blood flow to the coronary arteries, compensated by retrograde collateral circulation. This condition poses significant ischemic stress on a large portion of the myocardium, contributing to elevated mortality rates. While coronary artery bypass grafting (CABG) remains the standard method of revascularization, recent studies suggest that percutaneous coronary intervention (PCI) can be successfully employed in select patient populations, and may even represent the sole option for revascularization, particularly for high-risk patients. The advancements in PCI techniques and the availability

of a wide range of devices have contributed to the increasing success rates of CTO interventions. However, despite these advancements, instances of failed PCI attempts in CTO cases are still documented [2-5].

To illustrate the potential safety and efficacy of PCI in high-risk surgical candidates, we present a complex clinical case involving the revascularization of chronic total occlusions in the LMCA, left anterior descending (LAD) artery, and circumflex (CX) artery.

Methods

The study focused on a 62-year-old male patient with severe coronary artery disease, including chronic total occlusion of the left main coronary artery (LMCA), along with a history of previous myocardial infarction leading to ischemic cardiomyopathy and congestive heart failure of functional class III-IV (NYHA). The patient experienced recurrent symptoms such as dyspnea, retrosternal discomfort, hydrothorax, peripheral edema, and frequent hospitalizations [6,7].

A coronary angiography performed in 2014 revealed chronic total occlusion of the left anterior descending artery (LAD) with moderately developed right-to-left collaterals, and no significant stenosis in the right coronary artery (RCA).

Despite being assessed as a high-risk patient, the patient declined both stenting intervention and coronary artery bypass grafting (CABG), and also refused implantation of an Implantable Cardioverter-Defibrillator (ICD). Consequently, the patient was managed solely with medication treatment, with a prognosis indicating susceptibility to sudden cardiac death.

In May 2017, the patient was admitted to the “Aversi” Clinic due to acute heart failure. Subsequent to hospitalization, the patient underwent ultrasonography examination, and the SYNTAX score was calculated.

Recanalization procedures involved the utilization of the support-balloon technique and CTO wires (Miracle 3™ wire, Abbott Vascular; Runthrough® NS Intermediate wire, Terumo). Stenting was performed in the LAD, circumflex artery (CX), LMCA, and its bifurcation using three drug-eluting stents (Resolute Integrity DES, Medtronic). Bifurcation stenting employed the "Culotte Stenting" technique, followed by "Kissing Balloon" post-dilatation. Additionally, the proximal optimization technique was applied in the LMCA.

Results and Discussion

The ultrasound examination of the patient revealed significant cardiac impairment, with an ejection fraction (EF) of only 20% compared to the normal range of 55% or higher. The assessment indicated diffuse hypokinesis, along with dilated left ventricular dimensions, severe diastolic dysfunction, and mild regurgitation in the mitral, tricuspid, and aortic valves [8].

A SYNTAX score of 47 was calculated, indicating a high complexity of coronary artery disease. Despite previous medical treatment, which led to some improvement, further intervention was deemed necessary to address the patient's condition. After careful consideration and consultation with the patient and family members, a decision was made to proceed with repeated coronary angiography (CAG) and attempted revascularization, particularly of the left anterior descending artery (LAD) with stenting (Figures 1-3).

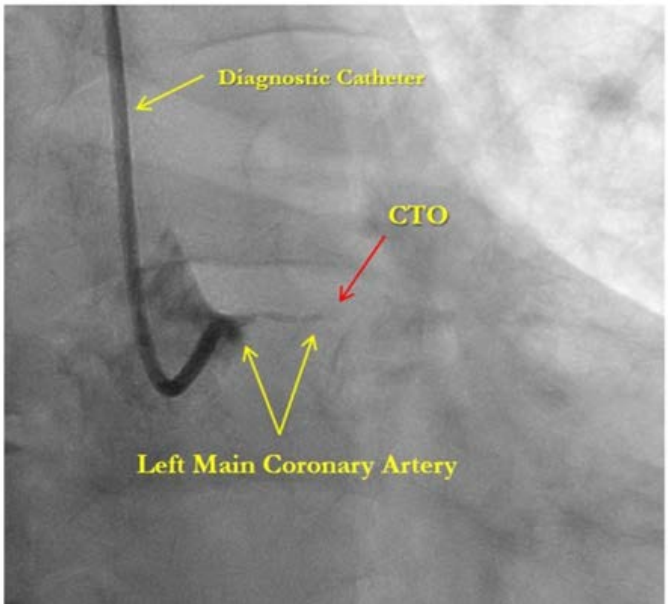

Figure 1: Chronic total occlusion of the left main coronary artery.

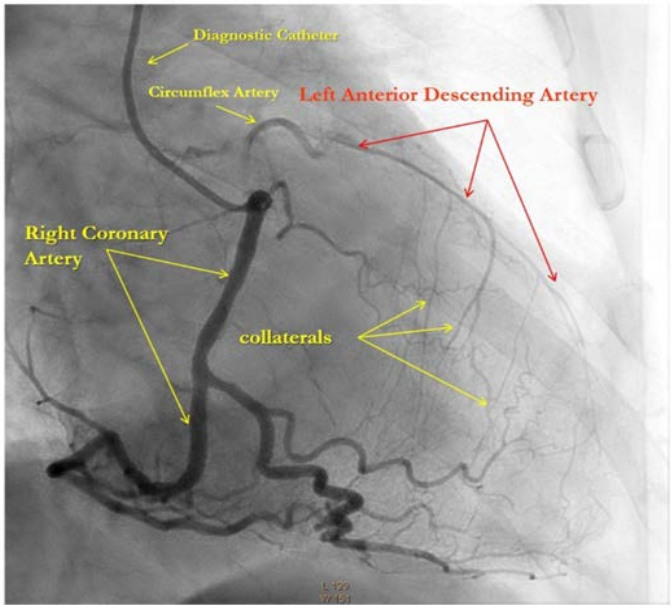

Figure 2: Right Coronary Artery with developed right-to-left collaterals.

However, the subsequent CAG revealed unexpected chronic total occlusion of the left main coronary artery (LMCA) and the circumflex artery (CX), in addition to the already known occlusion of the LAD. This presented a significant challenge, as the patient's heart was reliant solely on the right coronary artery (RCA) for blood supply. Acute occlusion of the LMCA carries a high risk of mortality, making successful revascularization imperative (Table 1) [9].

Despite the increased complexity of the procedure, including the recanalization of occluded arteries and the stenting of multiple vessels, the intervention proceeded. Utilizing advanced techniques such as the support-balloon technique, CTO wires, and drug-eluting stents, successful revascularization was achieved. The procedure, lasting over two hours, was performed with meticulous care to minimize the risk of complications (Figure 4).

Post-procedure evaluation showed remarkable improvement in cardiac function, with the ejection fraction increasing from 20% to 38%. Other parameters such as fractional shortening, ventricular dimensions, and pulmonary artery pressure also showed favorable changes, leading to a downgrade in the functional class of congestive heart failure from class III-IV to class I [10,11].

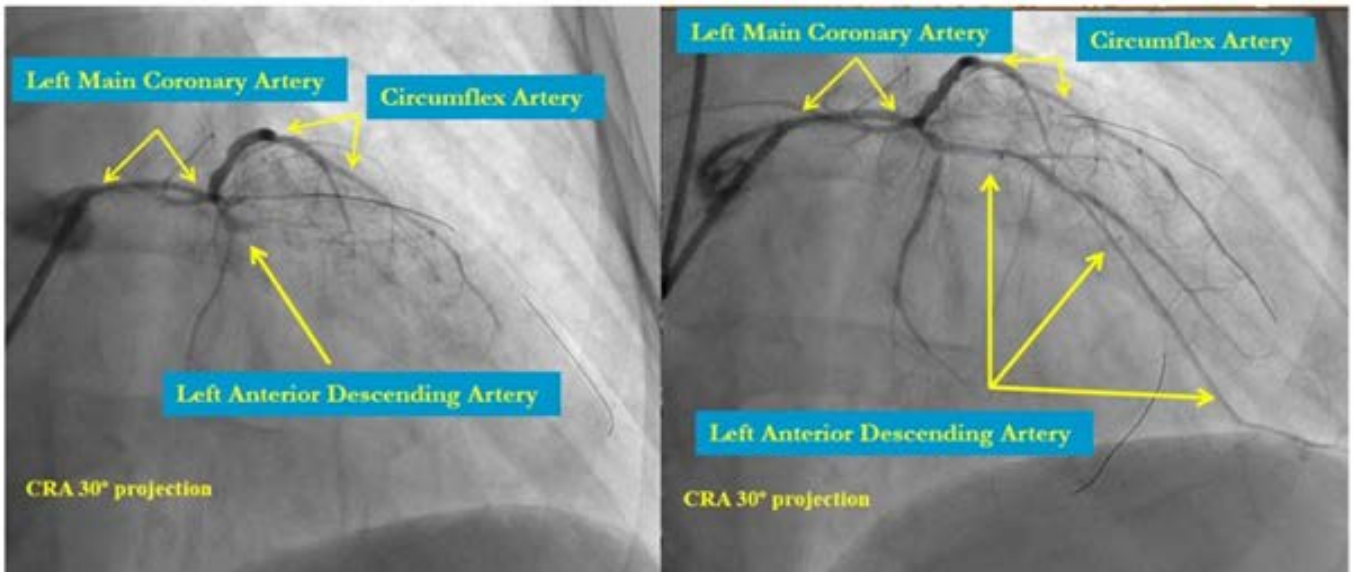

Figure 3: LMCA, CX, LAD after recanalization and predilatation.

Table 1: Patient's heart parameters before and after the intervention.

Parameter	Before Intervention	After Intervention
EF	20%	38%
Fractional Shortening (FS)	15%	25%
LVESD (Left Ventricular End-Systolic Dimension)	51 mm	38 mm
LVEDD (left ventricular end diastolic diameter)	60 mm	52 mm
LVEDV (left ventricular end-diastolic volume)	148 mm	89 mm
left atrium (LA)	44 mm	41 mm
Right Ventricule (RV)	38 mm	35 mm
Right Atrium (RA)	49 mm	38 mm
Systolic Pulmonary Artery Pressure (PAPs)	64mm/Hg	21 mm/Hg

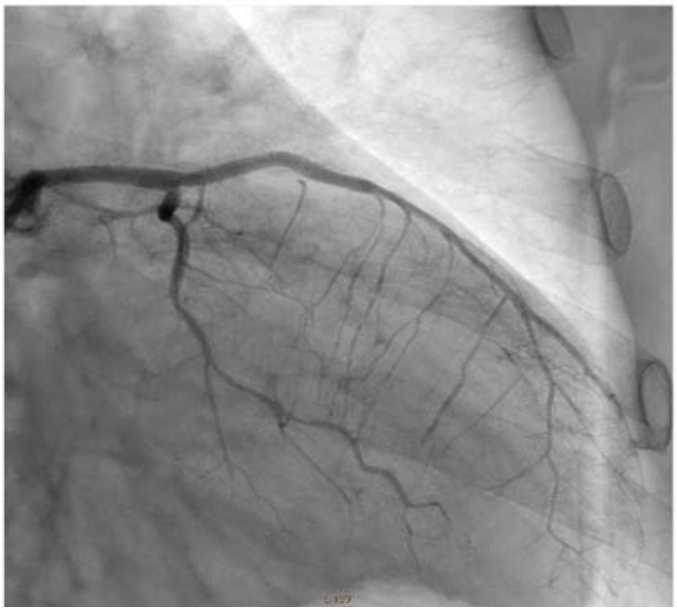

Figure 4: Left Coronary Artery, final result of the intervention.

Although the high SYNTAX score initially suggested surgical revascularization as the preferred option, the patient's poor functional status favored PCI due to its lower risk profile. Despite the technical challenges and limited resources, the intervention achieved an optimal angiographic result without the need for Intravascular ultrasound (IVUS) guidance, demonstrating the efficacy of the chosen approach.

Conclusion

Successful revascularization of LMCA CTO lesions via PCI can be achieved through careful patient selection and appropriate revascularization techniques. While Intravascular ultrasound (IVUS) guidance is not deemed obligatory, its use can significantly contribute to ensuring proper stent sizing, deployment, and confirmation of the final optimal result.

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