Case Report

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Successful Primary Percutaneous Coronary Intervention without Stenting: Insight from Optimal Coherence Tomography

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For patients with acute myocardial infarction, current management guidelines recommend implantation of a drug-eluting stent, dual antiplatelet therapy (including potent $P2Y_{12}$ inhibitors) for at least 1 year, and maintenance of life-long antiplatelet therapy. However, a pilot study showed favorable results with antithrombotic therapy without stent implantation when plaque erosion, not definite plaque rupture, was confirmed using optical coherence tomography (OCT), despite the patients having acute myocardial infarction. Here, we present a case where successful primary percutaneous coronary intervention was performed without stenting with the aid of OCT in a patient with ST-elevation myocardial infarction who developed thrombotic total occlusion of the right coronary artery.

Key Words: Acute myocardial infarction, percutaneous coronary intervention, optical coherence tomography, plaque erosion, antiplatelet agents

INTRODUCTION

Life-long maintenance of antiplatelet therapy after drug-eluting stent (DES) implantation is mandatory due to the risk of stent thrombosis.[1] Therefore, patients who undergo DES implantation with prolonged antiplatelet therapy must be concerned about bleeding after surgery or invasive procedures for the rest of their lives. We present a case of successful primary percutaneous coronary intervention (PCI) without coronary stenting with the aid of optical coherence tomography (OCT) in a patient with ST-elevation myocardial infarction (STEMI) who developed thrombotic total occlusion of the right coronary artery (RCA).

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CASE REPORT

A 50-year-old male presented with chest pain for a day, and the initial electrocardiogram (ECG) showed ST-elevation in the inferior leads. STEMI was diagnosed, and urgent angiography was performed after a loading dose of aspirin 300 mg and prasugrel 60 mg, which revealed total occlusion of the mid-RCA (Fig. 1A). After successful wiring with an 0.014-inch wire, angiography showed a large filling defect, a highly suspicious thrombus, on the mid-to-distal RCA (Supplementary Video 1, only online); this led to the performing of intracoronary injection of glycoprotein IIb/IIIa inhibitor and thrombus aspiration. After the thrombus aspiration was repeated several times, a large amount of thrombus was aspirated (Fig. 1B). Then, angiography showed intermediate stenosis in the mid-RCA and embolization of the posterior descending artery (PDA) branch, with a relatively good distal flow in the posterolateral branch (Fig. 1C); therefore, we proceeded to evaluate the RCA with OCT. OCT demonstrated a large intraluminal thrombus with-

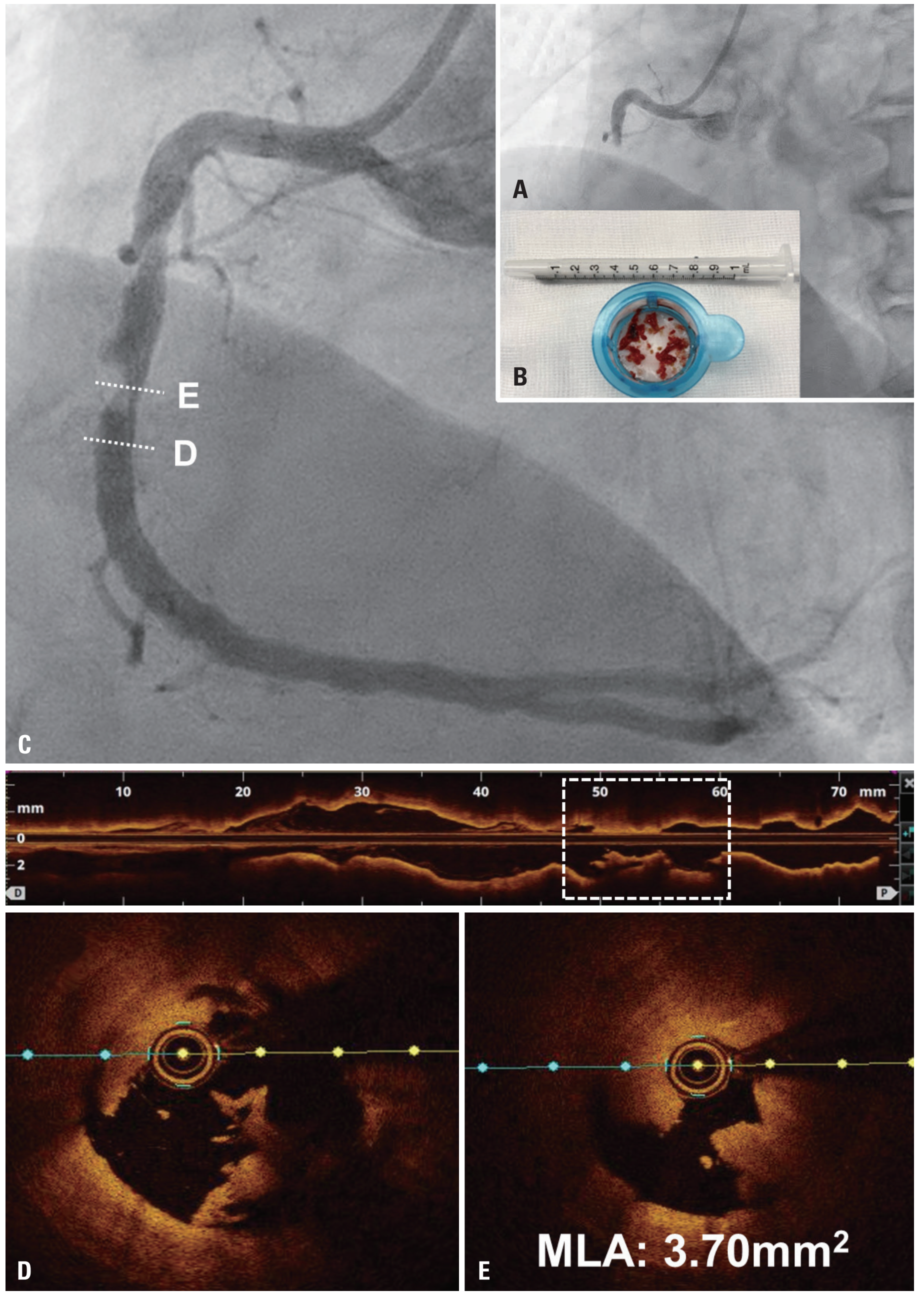

Fig. 1. Initial angiography and OCT imaging during index procedure. (A) Initial angiography showing total occlusion of mid-RCA. (B) Extracted thrombus after several thrombo-suction. (C) Intermediate stenosis in the mid-RCA with filling defect. (D and E) Non-flow limiting intraluminal thrombus with an MLA of 3.70 mm^2. OCT, optical coherence tomography; RCA, right coronary artery; MLA, minimal lumen area.

out evidence of ruptured plaque, suggesting probable plaque erosion, and a minimal lumen area (MLA) of 3.70 mm^2 on the culprit lesion (Fig. 1D, E and Supplementary Video 2, only online). The final angiography showed the remaining of the filling defect on mid-RCA with the occluded PDA branch (Supplementary Video 3, only online). At this time, the patient was asymptomatic and hemodynamically stable; therefore, stent implantation was avoided. A repeat angiography on day 7, maintaining aspirin 100 mg and clopidogrel 75 mg and low molecular weight heparin, demonstrated no filling defect of the mid-RCA and the recanalized PDA branch (Fig. 2A). Follow-up OCT demonstrated slight reduction of thrombotic burden in the mid-RCA and an increasing MLA of 4.74 mm^2 (Fig. 2B, C and Supplementary Video 4, only online). During hospitalization, cardiac magnetic resonance showed a preserved left ventricle ejection fraction (57%) and subendocardial delayed enhancement on the mid-to-basal inferior wall (infarct size: 10%). The reduction of intraluminal thrombus with the increasing MLA and recanalized PDA branch led to maintenance dual antiplatelet therapy (DAPT), including aspirin 100

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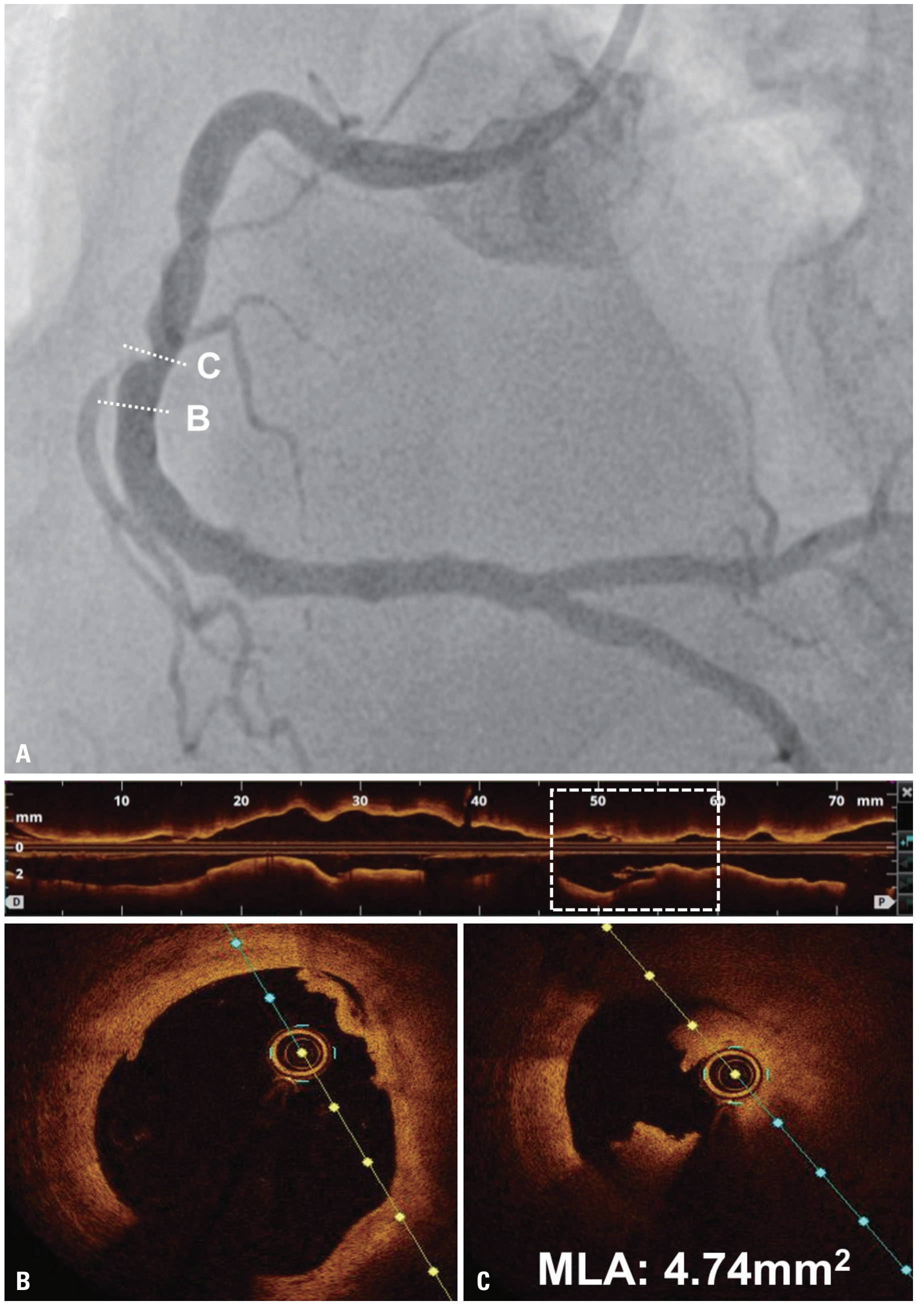

Fig. 2. After seven days of follow-up angiography and OCT imaging. (A) Follow-up angiography showing filling defect of mid-RCA. (B and C) Resolution of intraluminal thrombus with an MLA of 4.74 mm^2 on follow-up OCT. OCT, optical coherence tomography; RCA, right coronary artery; MLA, minimal lumen area.

mg and prasugrel 10 mg, for 6 months. The 1-month treadmill test demonstrated good exercise tolerance without ST-segment deviation on ECG (13.4 metabolic equivalents). The 6-month follow-up angiography showed mild stenosis in the mid-RCA with good distal flow (Fig. 3A). OCT demonstrated diffuse mixed plaque with fibroatheroma, an MLA of 5.74 mm^2, and complete resolution of intraluminal thrombus (Fig. 3B, C and Supplementary Video 5, only online). Moreover, the fractional flow reserve value was 0.98, which confirmed functional nonsignificance (Fig. 3A). Therefore, we decided to continue lifelong single antiplatelet therapy (aspirin) and high-intensity statin plus ezetimibe. Informed consent was obtained from a legal surrogate of the patient regarding the publication of this case report.

DISCUSSION

Postmortem histopathological studies have demonstrated that coronary thrombosis derived from plaque rupture is the

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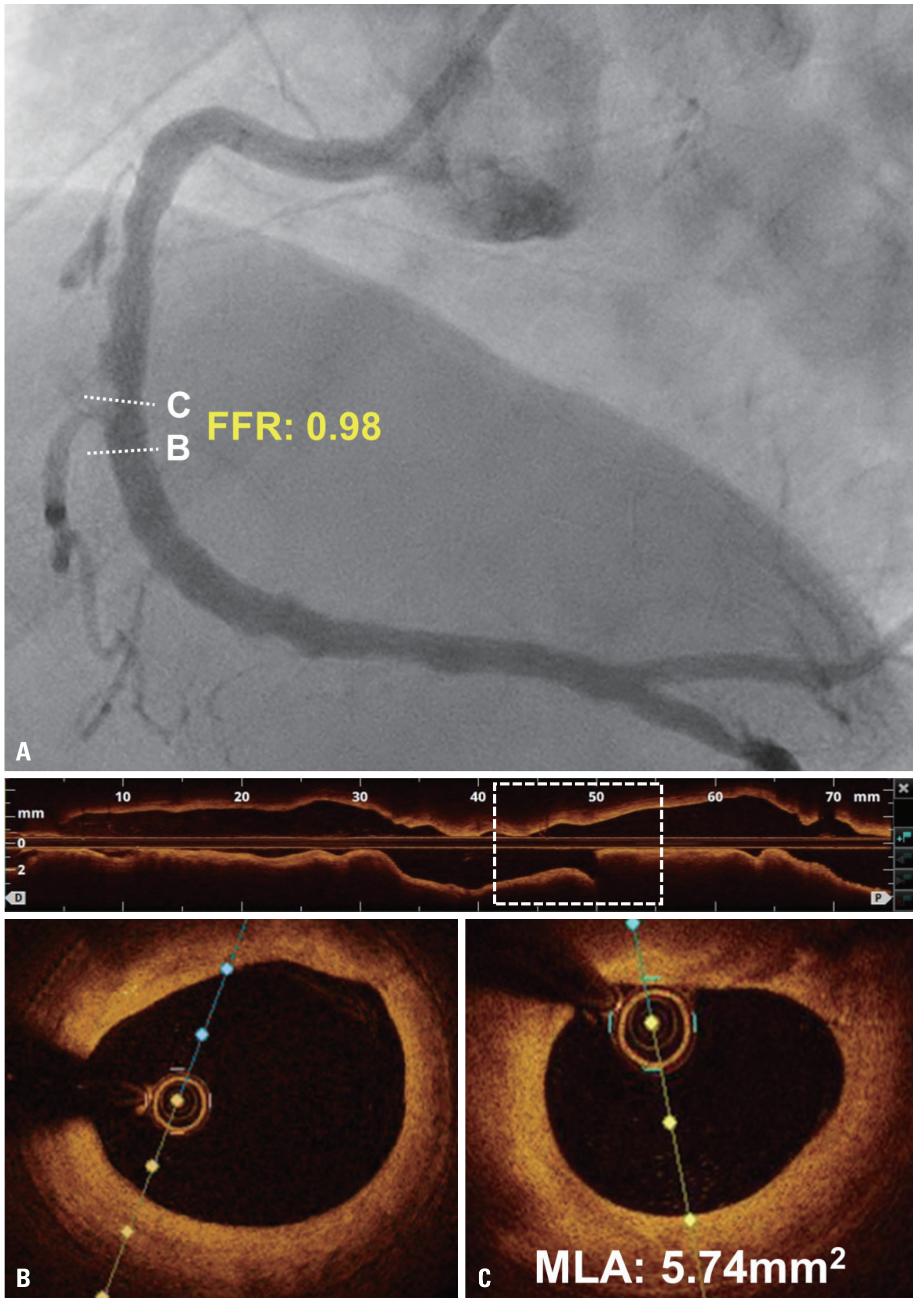

Fig. 3. Six-month follow-up angiography and OCT imaging. (A) Six-month follow-up angiography demonstrating mild stenosis of mid-RCA with 0.98 fractional flow reserve value. (B and C) Complete resolution of thrombus with an MLA of 5.74 mm^2 on 6-month follow-up OCT. OCT, optical coherence tomography; RCA, right coronary artery; MLA, minimal lumen area.

most common pathology in patients with acute myocardial infarction (AMI), including STEMI. Ruptured plaques have a necrotic core that is exposed to circulating blood flow via a fractured fibrous cap, causing thrombotic occlusion that impairs flow in the coronary artery.[2] Therefore, current guidelines for STEMI recommend DES implantation with DAPT, including potent $P2Y_{12}$ inhibitors and life-long maintenance of single antiplatelet therapy, to avoid stent thrombosis.[3] However, approximately up to 40% of patients with AMI were found to have other plaque morphologies, including plaque erosion, which include preserved vascular integrity with intact fibrous cap, larger residual lumen, and thrombus near an area of endothelial denudation.[4] Recently, in the treatment of AMI, the use of imaging modalities such as intravascular ultrasound (IVUS) and OCT has increased; this has improved clinical outcomes by physicians in checking the exact lesion characteristics, including plaque morphology or vessel dimensions, and post-PCI complications. Compared with IVUS, OCT provides approximately 10-fold superior resolution (10–15 μm) for clearer assessment of coronary lumen and plaque characteristics, overcoming the

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limitations of IVUS.[5] OCT alone enables the distinction between plaque erosion and plaque rupture in clinical practice.[6] For plaque erosion, a thrombus overlying a visualized intact cap is defined as definite plaque erosion; a thrombus or luminal irregularity without a visible plaque rupture site, as in our case, is defined as probable erosion.[7] A recent proof-of-concept study has demonstrated that patients with AMI and plaque erosion in a non-flow limiting lesion, confirmed using OCT, were successfully treated with antithrombotic therapy, allowing the avoidance of stent implantation for at least 1 year of follow-up. These studies included only patients with confirmed definite plaque erosion with intact fibrous cap and residual stenosis of less than 70% who were using potent antiplatelet agents such as ticagrelor, which might also affect the favorable clinical outcomes without stent implantation.[8,9] Although the outcomes of a pilot study are difficult to apply in daily practice, we successfully treated our STEMI patient without stenting through serial OCT evaluation with effective thrombus aspiration and proper pharmacological therapy. Our reason for deferred stenting was that stent placement in a heavy thrombus enhances the chances of distal embolization. Moreover, the occlusion of microvasculature leads to the no-reflow phenomenon, which is associated with increased mortality and infarct size, thus reducing the benefit of PCI.[10,11] Fortunately, in our case, serial OCT after 7 days showed no visible ruptured plaque and increased MLA with reduced thrombus. After 6 months of follow-up, OCT demonstrated no definite ruptured plaque and increased MLA with clear resolution of the intraluminal thrombus. No residual thrombus, confirmed by OCT, led to the use of single antiplatelet agent. However, future long-term studies will need to investigate how to balance the risk of ischemic and bleeding events for the patients with probable plaque erosion with heavy thrombus managed using antithrombotic therapy without stenting or deferred stenting. Recently, a prospective, multicenter, randomized controlled trial on OCT-guided primary PCI is ongoing to compare the reperfusion strategy and clinical outcomes of STEMI patients treated by angiography-guided versus OCT-guided PCI (EROSION III: OCT- vs Angio-based Reperfusion Strategy for STEMI; NCT03571269). The result of EROSION III trial is expected to reveal whether OCT can be considered for the decision-making in customizing and optimizing the reperfusion strategy in the setting of STEMI.

SUPPLEMENTARY DATA

Video 1. Angiography after successful wiring with 0.014-inch wire.
Video 2. Initial OCT.
Video 3. Final angiography during index procedure.
Video 4. Seven-day follow-up OCT.
Video 5. Six-month follow-up OCT.

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AUTHOR CONTRIBUTIONS

Conceptualization: Yongcheol Kim. Data curation: Ji Woong Roh. Formal analysis: Oh-Hyun Lee and Eui Im. Funding acquisition: Yongcheol Kim. Investigation: Yongcheol Kim and Ji Woong Roh. Methodology: Yongcheol Kim and Ji Woong Roh. Project administration: Yongcheol Kim and Ji Woong Roh. Resources: Ji Woong Roh. Software: Ji Woong Roh. Supervision: Yongcheol Kim, Ji Woong Roh, Deok-Kyu Cho, and Donghoon Choi. Validation: Yongcheol Kim and Ji Woong Roh. Visualization: Yongcheol Kim and Ji Woong Roh. Writing—original draft: Ji Woong Roh. Writing—review & editing: Yongcheol Kim, Oh-Hyun Lee, Eui Im, Deok-Kyu Cho, and Donghoon Choi. Approval of final manuscript: all authors.

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