

Percutaneous Coronary Intervention of a Chronic Total Occlusion

Treatment of a CTO in the left anterior descending artery.

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CASE REPORT

A 58-year-old man with a history of atrial fibrillation and prior coronary artery disease presented with increasing symptoms of exertional chest discomfort. He had a previous myocardial infarction in 1993, and cardiac catheterization at that time demonstrated a chronic total occlusion (CTO) of the left anterior descending artery (LAD) with collateral formation. He was medically managed and, despite this disease, had remained asymptomatic until the preceding few months, when he developed exertional angina, the symptoms of which were relieved by rest. Recently, he developed angina

while undergoing gastroscopy and required admission to an outside hospital for further evaluation. He was subsequently referred to our institution for diagnostic cardiac catheterization and coronary angiography.

Coronary angiography showed the presence of CTO of the proximal mid LAD just distal to the origins of the first diagonal and septal arteries, with faint collaterals from the right coronary artery (Figure 1A). No proximal "nipple" at the occlusion site was seen. His left ventricular ejection fraction was preserved at 60%, and there was no significant mitral regurgitation.

Because of persistent anginal symptoms, the patient

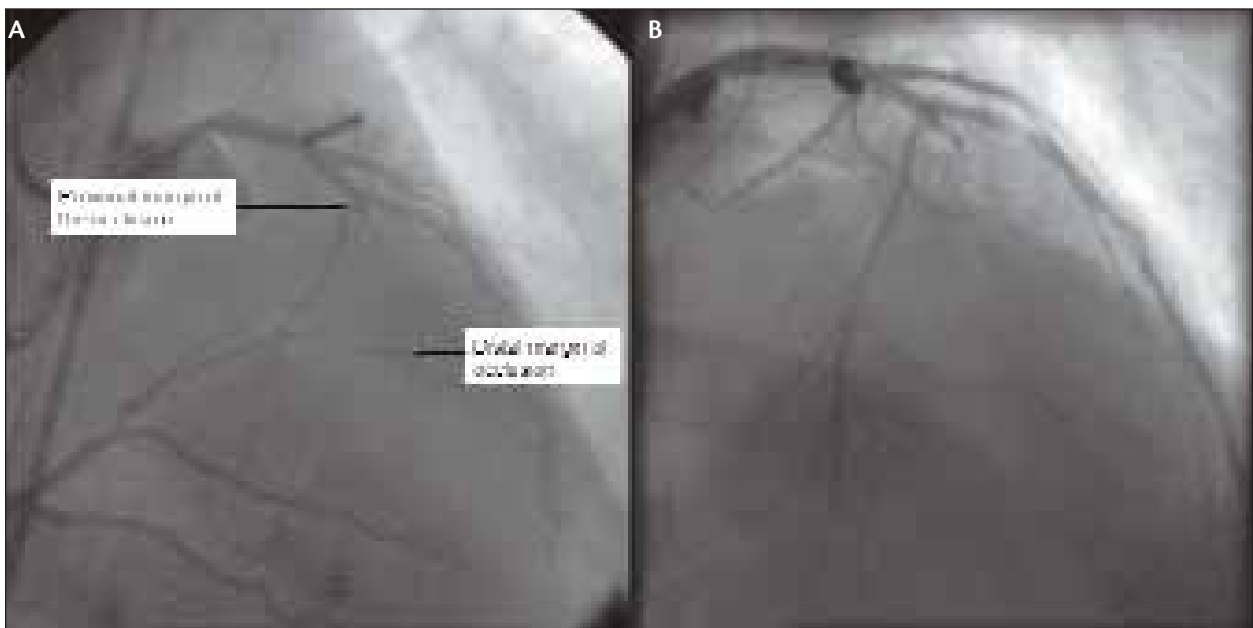


Figure 1. Angiographic image showing the CTO of the LAD (A). Angiographic image showing the CTO being probed with an Asahi Prowater Wire (Abbott Vascular, Santa Clara, CA) without success (B).

was enrolled in the US FACTOR (FlowCardia's Approach to Chronic Total Occlusion Recanalization) clinical trial using the Crosser device (FlowCardia Inc., Sunnyvale, CA). Informed consent had been obtained prior to the procedure. A 4-F, short side arm sheath was placed in the left common femoral artery, and an 8-F side arm sheath was placed in the right common femoral artery. Intravenous heparin was administered to maintain an activated clotting time >200 seconds. A 4-F Judkins Right 4 diagnostic catheter (Cordis Corporation, a Johnson & Johnson company, Miami, FL) was used to engage the right coronary artery without difficulty. This catheter was used throughout the procedure to perform contralateral injections to visualize the mid-distal LAD, which filled by collaterals from the right posterior descending artery. An 8-F XBLAD 3.5 guiding catheter (Cordis) was used to engage the left main coronary artery. Initial angiograms using antegrade (ipsilateral) and contralateral injections into the right coronary artery were obtained in multiple views to define the length and course of the CTO, which measured approximately 25 mm in length (Figure 1B).

The site of CTO in the LAD was then gently probed for 5 minutes of fluoroscopy time using a 300-cm Asahi Prowater (Abbott Vascular) wire without success. The site of occlusion was challenging in that a small septal artery arose at the site of occlusion without a clear antegrade nipple seen. The Crosser catheter was then advanced over the wire and activated for two runs, and the catheter passed easily into the segment of occlusion. The Crosser catheter was then withdrawn, and subsequent angiography revealed a tract into the area of occlusion, with faint antegrade flow distally into the mid-distal LAD (Figure 2).

Multiple wires, including the Asahi Prowater wire, BMW (balanced middle weight) Universal wire (Abbott Vascular), Miracle Brothers-3 wire (Abbott Vascular), and PT Graphix Intermediate wire (Boston Scientific Corporation, Natick, MA) were then used, without success, to enter the true lumen distal to the segment of occlusion. The parallel wire technique was used without initial success. Finally, a wire was passed into a septal artery near the distal edge of the occlusion, and a 1.5- X 9-mm Maverick balloon (Boston Scientific) was advanced into the septal artery. The wire was then withdrawn and, as the wire was pulled back, contrast material injection through the lumen of the balloon catheter revealed the tip to be in the true lumen of the mid-distal LAD. After some manipulation, a BMW Universal wire was able to pass into the mid-distal LAD. A 2- X 20-mm Maverick balloon was then used to dilate the mid and distal LAD. We then proceeded to deploy a 2.5- X 28-mm Cypher stent (Cordis) first in the mid-distal LAD, and 2.75- X 33-mm

and 3- X 18-mm Cypher stents proximally in overlapping fashion. The entire stented area was postdilated at high pressure using a 3- X 20-mm Quantum Maverick balloon. The proximal Cypher stent spanned the origin of the first major diagonal, but there was no significant plaque shifting into the ostium of this vessel.

All catheters and wires were withdrawn, and final angiography showed an excellent result within the stented portions of the mid-distal LAD, with all septals and diagonals patent. The distal LAD beyond the stented portion had TIMI 3 flow without evidence of dissection or perforation (Figure 3).

DISCUSSION

CTOs may account for up to one third of patients referred for coronary angiography and up to 10% of all percutaneous interventions.¹ Retrospective studies have suggested that revascularization of a CTO is associated with improved survival.^{2,3} Conversely, the recently published findings of the OATS trial suggested that percutaneous coronary intervention for a recently occluded infarct-related artery 3 to 28 days after an acute myocardial infarction is of no long-term benefit.⁴ However, the OATS study population is clearly different from a CTO population, which usually implies the duration of occlusion as longer than 3 months. Nonetheless, percutaneous therapies for CTOs are well known to be technically challenging, resulting in CTOs being an important reason for referral for bypass surgery.^{5,6} Procedural failure in percutaneous therapy of CTOs has been attributed to various causes, including long lesions (>15 mm), long duration of

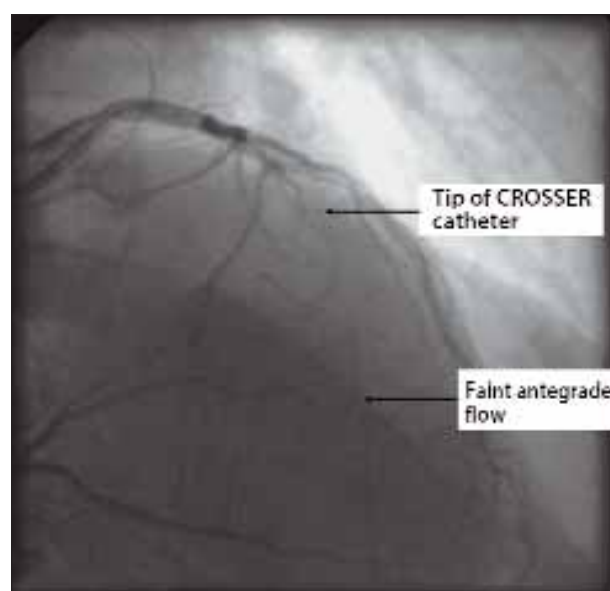


Figure 2. Angiographic image showing the Crosser device advanced into the lesion, with improved antegrade flow.

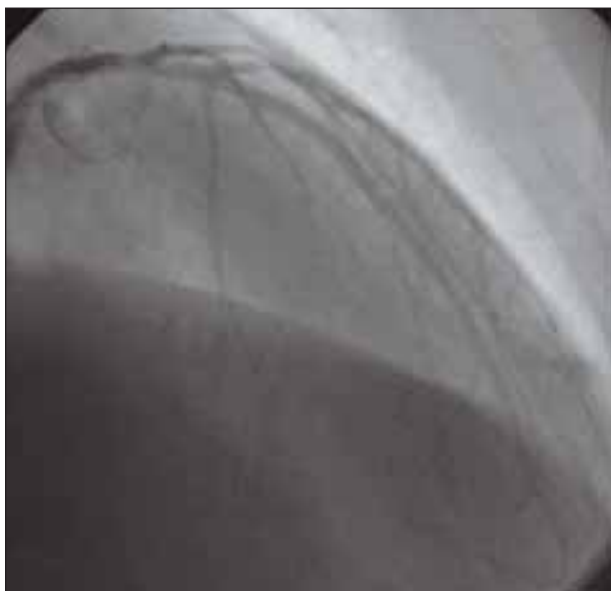


Figure 3. The final angiographic appearance.

occlusion (>12 months), heavy calcification, tortuosity (>45 degrees), abrupt stump, ostial or distal disease, presence of bridging collaterals, inability to cross the lesion with the balloon, and inability to dilate the stenosis.⁷⁻¹⁰ However, the primary challenge and reason for a technical failure in treating a CTO is inability to cross the occluded lesion with a wire.¹¹ Therefore, many technical innovations have been developed to address this challenge, including different techniques, wires, and devices.

Our patient exemplified the challenges involved in a CTO, which included the length of the lesion, the lack of a proximal nipple, the presence of a side branch at the occlusion point, poor visualization of the distal vessel despite contralateral injections, and subintimal re-entry. In such a situation, access to a broad armamentarium is helpful. In our patient, we used the Crosser device to aid us in penetrating the proximal cap and crossing the CTO.

The Crosser system has been studied previously in feasibility and safety studies.^{12,13} In the European pivotal study, which examined the use of the device in 25 patients in Italy, Germany, and Switzerland, a technical and device efficacy rate of 76% was reported.¹³ Melzi et al studied the Crosser in 28 patients with 30 CTOs.¹² He reported a technical success rate, defined as successful crossing of the lesion into the true lumen in 63%, and angiographic (<20% stenosis) and clinical success rate (defined as angiographic success and freedom from death, myocardial infarction, elective or emergency bypass surgery, or repeat percutaneous coronary intervention during index hospitalization and 30-day follow-up) of 53%. A pivotal study involving 19 sites and 125

patients in the US has recently been completed, and findings are expected soon. However, preliminary data (unpublished yet) suggests an efficacy rate of 61% in this study. There were no perforations, although one patient required bypass surgery after the procedure. Combining the results of the European and US experience, the combined efficacy rate is 63%. The efficacy of the system is consistent with other methods of crossing a CTO.^{6,14-17} However, because the use of one technique or device does not preclude the use of another different device, the Crosser system is an innovative and promising new tool in the percutaneous treatment of CTOs. ■

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