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Progressive collateral stenosis leading to symptomatic chronic total occlusion

Farhan Shah, MD; Andrew Maiolo, MD | HCA

Introduction

Chronic total occlusion is defined as the complete obstruction of a coronary artery, with TIMI 0 or TIMI 1 flow, and an occlusion duration of greater than 3 months. We present a case of symptomatic chronic total occlusion in a functional 79 year old female with no past history of coronary artery disease, previously asymptomatic due to robust collateral circulation.

Case Report

The patient is a 79 year old White female with a past medical history of chronic lymphocytic leukemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, who presented to the emergency department complaining of sharp, intermittent chest pain that radiated to the neck, jaw, left arm with associated tingling and numbness in the left fingers. She has no previous cardiac history and never had these symptoms before. Initial and repeat troponin levels were negative. Physical exam revealed normal S1, S2, without any abnormal heart sounds heard, normal rate and rhythm.

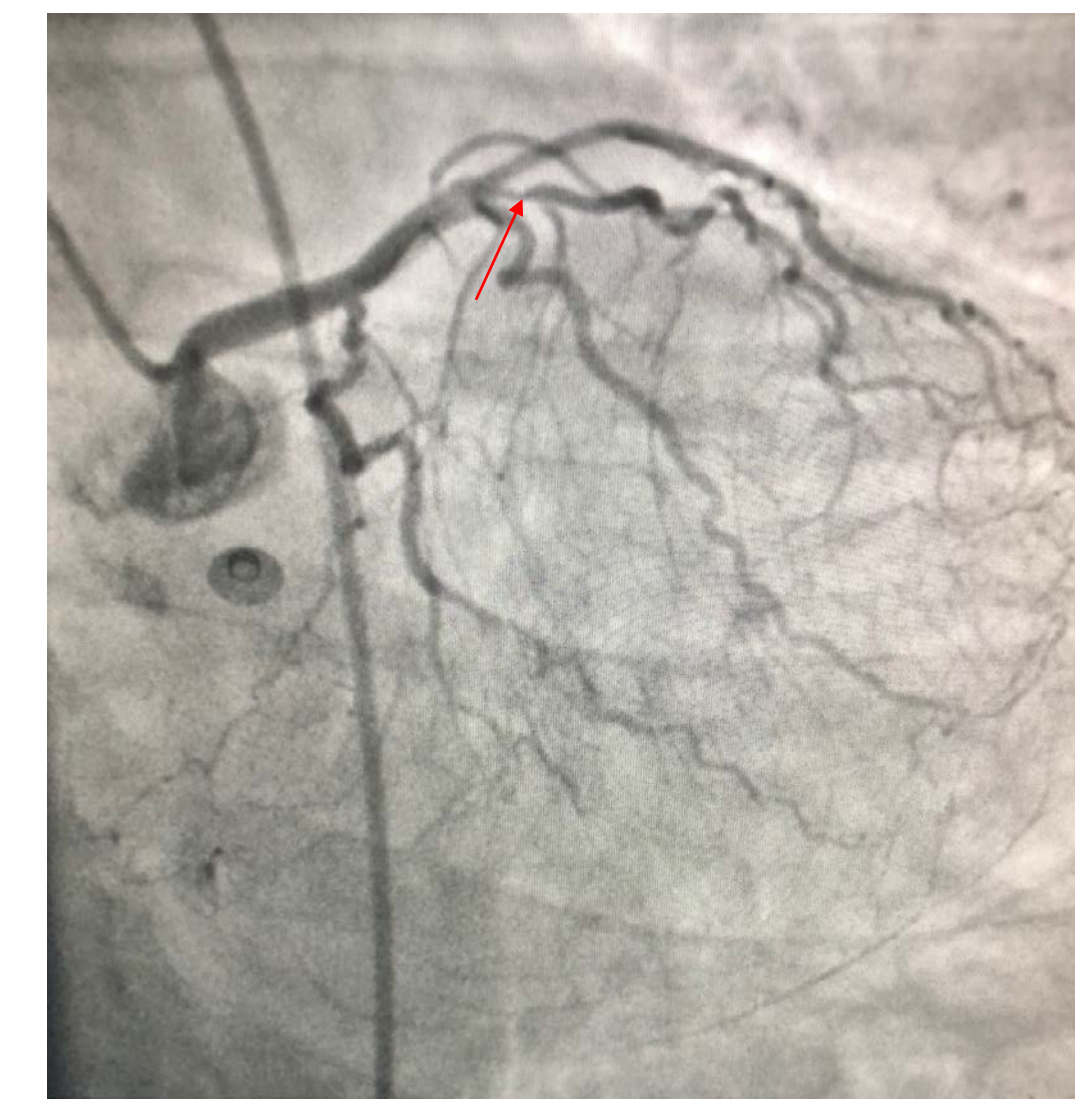
Chest X-ray showed stable cardiomegaly. Nuclear Stress test showed findings worrisome for ischemia of the apical septal, anterior apical lateral and basal inferolateral wall, significant left ventricular dysfunction with abnormal wall motion, characterized as a high risk exam. Ejection fraction was 31% and global hypokinesis was present.

The patient underwent diagnostic catheter angiography. Left anterior descending artery showed 80% stenosis (TIMI-3 flow) with collateral circulation supplying the distal right coronary artery territory. The left circumflex artery gave off minimal left-to-right collaterals, as well, filling the distal right coronary artery territory. There was complete total occlusion (CTO) of the mid right coronary artery. Ultimately, it was noted that the progressive stenosis of the left anterior descending artery leading to its inadequate collateral circulation to the completely occluded right coronary artery's territory, further worsened the ischemia and was most likely the cause of the patient's new onset angina.

Afterwards, the patient underwent percutaneous coronary intervention (PCI). The guide wire could not pass through the mid right coronary artery due to chronic total occlusion. However, the guide wire was able to cross through a micro channel into the distal vessel. Several attempts were necessary with varying sized balloons to predilate the artery. Successful implantation of 2 drug-eluting stents occurred. Final angiographic result was 0% residual stenosis and TIMI-3 flow. The patient was discharged the following day and further staged percutaneous coronary intervention of the mid left anterior descending artery would occur in 2-4 weeks.

Figures

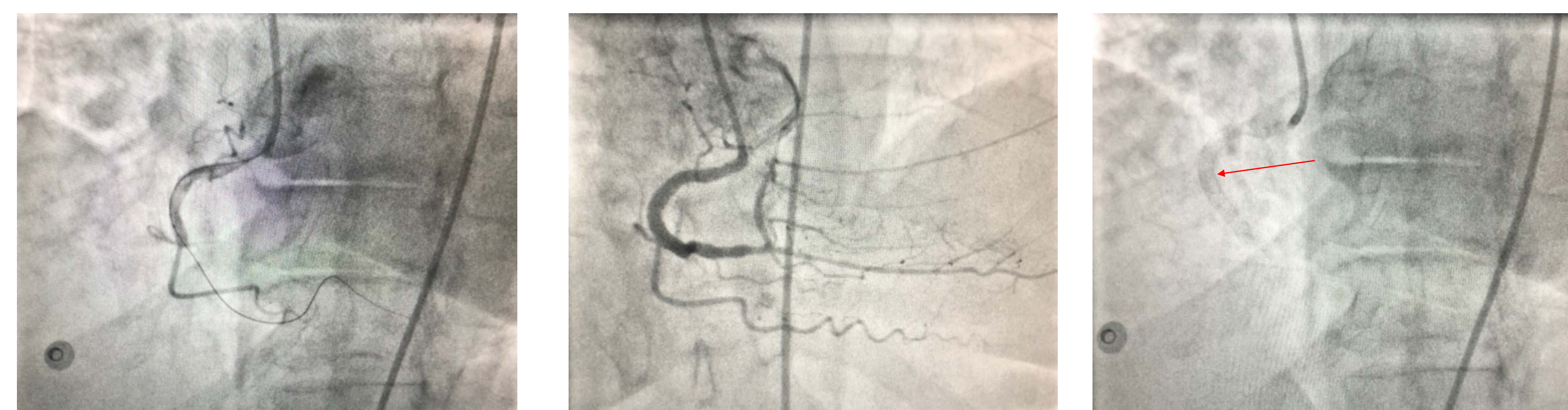
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Discussion

Prevalence of CTO in patients with known coronary artery disease has been documented as ranging from 30 to 50%. According to data in the National Heart, Lung, and Blood Institute Dynamic Registry between 1997 and 1999, in patients who underwent PCI, CTOs were frequent and more likely encountered in the older population. At least one CTO was in 36.5% of patients < 65 years, 39.1% in those who were between 65-79 years, and 40.7% in those ≥ 80 years of age. Specifically, the right coronary artery was the most commonly affected coronary vessel, followed by the left anterior descending and left circumflex arteries (1).

However, despite recent advancements in percutaneous coronary intervention outcomes, revascularization treatments of chronic total occlusion by percutaneous coronary intervention historically remains low, due to fear of adverse outcomes such as cardiac perforations. PCI is only performed on around 10% to 15% of patients with CTO (1). According to the Bypass Angioplasty Revascularization Investigation (BARI) trial, the presence of a CTO was the most common angiographic factor leading to the decision against enrollment and subsequent referral for coronary artery bypass graft (CABG) and treatment with medical therapy. When a CTO was present in the BARI trial, 10% received PCI, 40% received CABG, while 50% received medical therapy. When a CTO was not present, instead 35% underwent PCI, 30% underwent CABG, and 35% received medical therapy (2,3). In the past, PCI for a CTO had low success rates of about 50%, leading to the consideration that CABG was the gold standard of achieving complete revascularization (3). Treating CTO by PCI is considered technically challenging, due to several difficulties such as the inability to cross the obstruction with a guidewire, the inability to cross the obstruction with a balloon following the successful guidewire passage, the inability to deliver or expand a stent across the lesion, or ultimately the perforation of the vessel with a guidewire (1). The four main techniques for successful PCI of CTO, include antegrade wire escalation, antegrade dissection and reentry (ADR), retrograde wire escalation, and retrograde dissection and reentry (3). As seen in the PROGRESS CTO registry (Prospective Global Registry for the Study of Chronic Total Occlusion Intervention), skilled operators can have high success rates of 91% with low major complication rates of around 1.7% (3). This is further endorsed by the 2011 American College of Cardiology/American Heart Association guidelines for PCI which state: "PCI of a CTO in patients with appropriate clinical indications and suitable anatomy is reasonable when performed by operators with appropriate expertise" (4).

Fractional flow reserve (FFR) is a coronary catheterization technique used to determine if coronary artery stenosis is significant enough to justify PCI. It is defined as "the maximal blood flow to the myocardium in the presence of a stenosis in the supplying coronary artery, divided by the theoretical normal maximal flow in the same distribution" (5). Fractional flow reserve has shown persistent ischemia in CTO lesions despite collaterals, indicating that the collateral circulation of CTOs are not sufficient to correct ischemia (3). In a study comparing 50 CTO patients versus 50 patients in a non-CTO control group, FFR of the ischemic zone post-PCI improved to the same absolute level in both CTO and non-CTO lesions, meaning successful PCI on CTO lesions resulted in an even higher relative benefit than their non-CTO counterparts, as evidenced by FFR improvement (1,6).

Despite the technically challenging nature of CTO PCI, newer techniques and evidence-based research backing its efficacy has led to its increase usage and subsequent shift in clinical interventional management of patients with CTO.

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