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Case Report

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Subtotal occlusion of the left anterior descending artery requiring orbital atherectomy: A case report

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Abstract

Severe coronary artery calcification can be a complicating factor for cardiac catheterization interventions, increasing the difficulty of stent deployment and therefore raising the complication rates during the procedure. Orbital atherectomy, originally intended for large vessel atherectomy, is now rising as an intervention for severely calcified coronaries before stent deployment. However, limited data currently exists for complex cases where orbital atherectomy is used.

This case report will demonstrate a successful orbital atherectomy to a total occlusion of the left anterior descending artery, and then discuss the history, pathophysiology, and current literature regarding the topic of orbital atherectomy.

Introduction

Arterial calcification is a known risk factor for vessel patency and limb ischemia and thought to be translatable to risk for acute coronary events. However, not only are they seen as possible risk factors to myocardial ischemia but increase the difficulty of resolving an infarction when it occurs through the technical difficulty of deploying stents in a calcified coronary. Atherectomy has been the intervention of choice, with one of the first ideas coming from rotational atherectomy, which gained recognition after the ERBAC (1997) and ROTAXUS (2013) studies [1-3]. Orbital atherectomy came about as an alternative way of clearing the coronaries using a rotating crown that could change intervened size depending on how fast it rotated. ORBIT I (2013) and ORBIT II (2014) demonstrated the efficacy of this form of atherectomy, and its use is demonstrated in this case report.

Case report

81-year-old male with mast medical history of hypertension, hyperlipidemia, hypothyroidism, prostate cancer status-post treatment, presented to the emergency room in October 2018 after a witnessed out-of-hospital ventricular fibrillation arrest.

The patient was in his usual state of healthy walking with family when he suddenly collapsed. CPR was initiated immediately, and 2 shocks delivered within 10 minutes, achieving return of spontaneous circulation. By the time he arrived to the emergency department, he was altered and with poor inspiratory drive, and intubated immediately. Physical exam was pertinent for an irregularly irregular heart rate, not alert and oriented at all, pupils equal and reactive to light. Initial rhythm showed atrial fibrillation with new right bundle branch block and frequent pre-ventricular contractions. EKG showed ST-elevations in II, III, aVF with reciprocal ST-wave inversions in V1 and V3. The patient was urgently taken to the cardiac catheterization lab for intervention.

Cardiac catheterization entry was through the right radial artery. An ICY catheter was implemented as well due to the patient being under hypothermia protocol status-post cardiac arrest. Diagnostic catheterization revealed triple vessel disease: 70-90% occlusion of the right coronary artery with severe calcification, subtotal occlusion of the left anterior descending (LAD) artery with severe calcification, and 50-60% occlusion of the left circumflex artery. Ventriculogram showed a severely hypokinetic postero-lateral apex with hypokinesis of the lateral diaphragmatic and anterolateral apical-septal regions of the heart. The SYNTAX lesion score for each of the arterial areas were as follows: proximal LAD – 11; mid LAD – 8; LAD D1 – 2; proximal RCA - mid RCA – 5; proximal LCx – 6; LCx OM2 – 2; for a total SYNTAX score of 39. Due to these findings, the LAD was deemed the culprit lesions and the first to be intervened on.

Due to the severe calcific stenosis, pre-stenting required orbital atherectomy with the Diamondback 360 (CSI360) catheter. Balloon angioplasty was completed with the Encore 26, and final stent placement in the proximal and mid LAD were done with the drug-eluting stent Synergy. Post-stent flow improved from a TIMI flow score from 2-3 for both intervened areas, and stenosis improved from 99% (subtotal occlusion) to 0-10% occlusion. Patient was returned to the CCU for continued hypothermia protocol, and plan for staged PCI-intervention once neurological recovery after cooling protocol is noted.

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Discussion

Coronary artery calcification is quite common, ranging between 50-80% of men and 20-45% of women, [4] more so in the elderly population, with one study showing a 67% prevalence in those >60 years old [5]. The exact pathophysiology and impact of coronary calcification is still debated: current literature suggests calcification as an inflammatory response to atherosclerosis in an attempt to stabilize coronary plaques [6]. Thus, it is moreso the unstable, poorly calcified plaques that initiate a myocardial infarction.

Calcific coronaries may not be the cause of ACS in itself, but when ACS does occur, management and treatment become much more difficult. The gold-standard of treatment for MI is cardiac catheterization with stent placement. However, rates of complication peri- and post-PCI rise with the severity of coronary calcification, including difficulties with expansion and implementation of balloon/stent, and therefore increased risk of perforation and stent restenosis, respectively [7-9]. The current practice with severely calcified coronaries is now to precede with atherectomy to decrease calcific burden of the coronary before stent deployment.

Initial ideas of atherectomy stemmed from excisional atherectomy from peripheral vascular procedures, eventually leading into rotational atherectomy, and now orbital atherectomy [10]. Rotational atherectomy is done with a diamond-covered tip that drills through the plaque, only making a hole as large as the drill bit. In comparison, orbital atherectomy uses an orbiting diamond-covered crown, allowing for a larger surface area of plaque sanding/drilling, and consequently lower rates of no-reflow [11-12]. Indications for rotational atherectomy from expert consensus include moderate-severely calcified lesions [13-14]. For orbital atherectomy, indication adds on severe calcification of *de novo* lesions [15]. ORBIT II looked at orbital atherectomy and concluded superiorly lower rates of complication compared to rotational atherectomy [16]. Sub-analyses of orbital atherectomy (using Cardiovascular System Inc.'s Diamondback 360 peripheral orbital atherectomy system) show no increased morality with age, similar outcomes between large and small coronaries, and even success in subtotal occlusion [17-19]. Thus, ACC/AHA suggest consideration of atherectomy for severe calcium of coronary de novo lesions.

Even more complicated are coronary total occlusions (CTOs), which have increased risk of coronary artery perforation, collateral vessel loss, and higher contrast requirement for visualization, with risks increasing further given their low prevalence rate, reported at only about 4%. At this time, there are not many reported cases of total occlusion in current literature. ORBIT II describes intervention in >95% occlusions with a successful <50% stenosis post-intervention at a rate of 98%, in comparison to a success rate of ~59% percent without. However, ORBIT II does not differentiate between >99% and >95%, with a patient population of 93 [20]. Case reports are also rare, with only 2 cases described on the CSI360 (Diamondback) website without report of severity of calcification [21] and 1 case report noted by Trayer et al. for a 95-99% CTO [22].

Conclusion

Orbital atherectomy is a well-known method of intervention for severely calcified coronary arteries in preparation for stenting afterwards, decreasing technical difficulty and the rate of complications during the procedure, and these statistics will only improve as orbital atherectomy becomes more widely used and practiced. Its indication includes use in *de novo* lesions, but, as this case demonstrates, its use can continue to be expanded even in the most complicated cases including total occlusion. Current literature does not demonstrate large pools of data for orbital atherectomy use in CTO, and this case report hopes to lend way for further trial and practice in this niche.

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