Isolated right coronary artery bypass grafting via minimally invasive approach in two elderly patients with failed percutaneous coronary intervention

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Coronary artery bypass grafting (CABG) traditionally involves revascularization of the left anterior descending artery (LAD) as it is usually of greater prognostic value. Isolated CABG for non-LAD lesions have also been described in literature. However, these were often in the setting of re-do CABG or in patients with isolated right sided coronary lesion and concomitant valvular heart disease.

Given the significant morbidity and risks associated with CABG, appropriate patient selection is paramount. Advances in surgical techniques have afforded us less invasive approaches, resulting in less morbidity and faster recovery for patients, making surgical revascularization more attractive.

We describe two cases of novel surgical revascularization in elderly patients via minimally invasive approach for isolated severe right coronary artery (RCA) disease. Both patients had large dominant RCAs supplying large myocardial territories and had required revascularization, but had unsuccessful percutaneous coronary intervention (PCI) as a result of challenging coronary anatomy.

CASE 1

A 77-year-old male with a history of hyperlipidemia and end stage renal disease on hemodialysis presented with acute coronary syndrome (ACS). He also had a history of anemia and radiation proctitis. Electrocardiogram (ECG) showed T wave inversion in the anterior leads and troponin level was 3016 ng/L. Transthoracic echocardiogram showed a mildly depressed ejection fraction of 45% with regional wall motion abnormalities in the inferior walls with no significant valvular abnormality.

Coronary angiography (Figure 1A&B) via right radial approach showed a dominant tortuous RCA and multiple heavily calcified lesions in the RCA: 90% stenosis in the ostial RCA, 70% stenosis in the mid RCA and 80% stenosis in the distal RCA. There was mild coronary artery disease in the left coronary system with mid LAD myocardial bridging. In view of the complex anatomy, a heart team discussion was held. After reviewing the options with the patient, a shared decision was made to attempt PCI of the RCA with planned rotablation of the calcified lesions prior to stenting.

The RCA was engaged with a 7Fr Judkins Right 4 guiding catheter via right femoral approach to provide better support. The calcified ostial lesion was challenging to wire, and eventually the lesion was crossed with a Runthrough NS guidewire. However, both the guiding catheter and guidewire slipped out when we attempted to advance a 1.25 × 15 mm semi-compliant balloon. Next, we wired the RCA with a Sion Extra Support guidewire and with support of a Caravel microcatheter managed to advance the guidewire successfully into the right posterolateral (RPL) branch. However, we could not advance the microcatheter into the distal RCA to facilitate an exchange to a Rota Extra-support guidewire for rotablation. The ostial RCA was pre-dilated with 1.5 × 15 mm and 2.0 × 15 mm semi-compliant balloons but the balloons could not be advanced to the...
mid RCA (Figure 1C). Further attempts to re-insert the microcatheter were unsuccessful and led to the entire system being disengaged from the RCA.

In view of overwhelming anatomical and technical challenges, we decided to stop the PCI. Given the stenoses involve multiple segments along the RCA, it was likely that multiple long drug-eluting stents would be required. Moreover, the patient would not have been an ideal candidate for prolonged dual antiplatelet therapy (DAPT) after stent implantation in view of increased bleeding risks.

The RCA was the culprit vessel for the patient’s ACS and supplied a large territory of myocardium. It had resulted in the patient developing episodes of intra-dialytic hypotension with dynamic ECG changes. As such, conservative management with medical therapy would have been inadequate. Revascularization was planned via isolated RCA bypass surgery after discussion with the cardiothoracic surgeons.

The RCA bypass was achieved with a minimally invasive technique via a right mini-thoracotomy (Figure 2). Cardioplegia was induced and he was placed on cardiopulmonary bypass (CPB). The RCA target was exposed and stabilized. A saphenous venous graft was harvested then anastomosed to the aorta and the distal RCA. The patient also had left atrial appendage closure and MAZE procedure performed at the same setting. He was weaned off CPB uneventfully and sent to the cardio-thoracic intensive care unit (CTICU) thereafter.

He recovered well post operatively and was transferred to the general ward on day 6. His pain was well managed with oral analgesia. During the admission he developed tachy-brady syndrome necessitating implantation of a permanent pacemaker and also had creation of a new arterial-venous fistula for dialysis. He was subsequently discharged on day 25. He was well during his latest clinic review (> 1 year post CABG) and has been symptom free in his daily activities.

CASE 2

A 71-year-old male with a history of diabetes mellitus and chronic kidney disease presented with angina. Myocardial perfusion imaging had showed a large partial thickness infarct in the inferior and inferolateral wall with mild to moderate superimposed ischemia.

He had a previous drug eluting stent (4.0 × 18 mm) implanted for an ostial RCA lesion (Figure 3A&B) two years ago. Transthoracic echocardiogram showed a normal ejection fraction of 50% with regional wall motion abnormalities noted in the inferior walls with no significant valvular abnormality.

Coronary angiography (Figure 3C) via right radial approach showed a dominant tortuous RCA with an inferior-take-off origin and critical in-stent restenosis (ISR) with Thrombolysis in Myocardial Infarction (TIMI) 2 flow distally. There was mild coronary artery disease in the left coronary system.

The inferior-takeoff of RCA ostium, tortuous right brachio-cephalic artery and the presence of an ostial RCA stent presented significant difficulty to engagement with a guiding catheter. Subsequently, we managed to engage the RCA with a 6Fr Ikari Left (IL) 3.5 guiding catheter, but had difficulty wiring the ISR even with a 1.0 × 10 mm balloon for support.

We switched to a femoral approach to get better support. Despite using multiple guiding catheters (Amplatz Left 0.75, 1.0; Multi-Purpose), only the IL 3.5 guiding catheter could engage the RCA, albeit with poor support. We used a variety of guidewires (Sion Black, Run-through NS and Fielder XT) but could only wire partially into the ostial RCA stent (Figure 3D). Attempts to use a 1.0 × 10 mm balloon...
for support resulted in the guiding catheter being disengaged repeatedly. The decision was made to stop the PCI procedure because of insurmountable technical and anatomical difficulties.

The RCA was supplying a large territory of myocardium and had resulted in significant symptoms for the patient’s daily activities despite optimal medical therapy. As such, the patient was planned for revascularization via isolated RCA bypass surgery after discussion with the cardiothoracic surgeons.

The RCA bypass was performed with a minimally invasive technique (on pump) via a right mini-thoracotomy. The right internal mammary artery (RIMA) was initially harvested but had poor flow, likely due to dissection possibly from trauma from retractors. The RCA target was stabilized with an Octopus Nuvo stabilizer. His left saphenous vein was then harvested and anastomosed to the aorta and the distal RCA with the use of an intravascular shunt to prevent ischemia. A Medistim flowmeter revealed excellent flow within the graft, and postoperative transesophageal echocardiogram showed preserved left ventricular systolic function. He was sent to the CTICU thereafter.

He recovered well post operation and was transferred to the general ward on day 2. His pain was well controlled with oral analgesics and subsequently was discharged on day 7 uneventfully. He was well during his latest clinic review (> 1 year post CABG) and has been symptom free in his daily activities.

In most patients, lesions in the left coronary circulation carries greater prognostic importance. A previous study had shown that the presence of occluded RCA in the EXCEL trial population was not significantly associated with adverse cardiac outcomes at three years follow-up. Coupled with the morbidity and risks associated with CABG, we traditionally reserve CABG for patients with significant left side lesions, particularly in the left main or proximal LAD.

However, every patient’s coronary anatomy is unique and as shown by the above two cases, the presence of significant stenoses in the setting of dominant and large right coronary circulations can result in significant morbidity for patients.

Both patients required revascularization in which PCI as the preferred first line method was attempted but failed due to technical and anatomical difficulties. Remaining options will be surgical revascularization or medical therapy which was likely to be suboptimal solution for both patients. In such patients, if the RCA lesions are non-stentable, we should consider surgical revascularization.

Advances in surgical techniques have resulted in development of minimally invasive approaches, res-
ulting in less morbidity, better cosmesis and faster recovery for patients. Surgical revascularization achieved via a minimally invasive method has been shown to have similar outcomes compared to a midline sternotomy and significantly reduced hospital stay. This has increased patient’s acceptance for consideration of novel surgical revascularization instead of the traditional open-heart surgery. Although minimally invasive surgical revascularization is a challenging operation with a steep learning curve, it can be performed elegantly and effectively by highly experienced surgeons, as illustrated by our two patients.

These two cases demonstrated the importance of tailoring revascularization strategies to each patient’s individual clinical condition and coronary anatomy. Severe RCA disease, particularly in the setting of large dominant RCAs, can confer significant morbidity to patients, for which revascularization is important. In the appropriate patient population including the elderly, right anterior mini-thoracotomy for isolated RCA bypass is a viable therapeutic option, particularly in non-stentable RCA stenosis.

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