Percutaneous Coronary Intervention of Unprotected Left Main Coronary Artery in Cardiac Allograft Vasculopathy: A Case Series of Pediatric Patients

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Abstract

Cardiac allograft vasculopathy is a major cause of morbidity and mortality in orthotopic heart transplantation. The optimal management remains uncertain, especially in left main coronary artery lesions. With the limited data available in the literature, we present a review of three pediatric cases of cardiac allograft vasculopathy, involving the left main coronary artery, treated with percutaneous coronary intervention.

Key words: cardiac allograft vasculopathy; orthotopic heart transplantation; percutaneous coronary intervention

Citation: Tankazyan, H.H., Stoletniy L.N., Sakr A., Jutzy K.R., and Hilliard A.A. Percutaneous Coronary Intervention of Unprotected Left Main Coronary Artery in Cardiac Allograft Vasculopathy: A Case Series of Pediatric Patients. International Cardiovascular Forum Journal. 2015;4:61-63 DOI: 10.17987/icfj.v4i0.139

Introduction

Presented is a case series of three patients with cardiac allograft vasculopathy (CAV) following transplantation during their pediatric years. CAV is a well-documented phenomenon seen in patients following orthotopic heart transplantation (OHT) and is a major cause of morbidity and mortality. Given the lack of data on left main coronary artery (LMCA) intervention in CAV, the choice between a surgical and percutaneous revascularization strategy is made very difficult. We will be discussing our management of three young patients treated at our facility that received their transplantation during childhood and developed LMCA CAV in early adulthood.

Case 1:

A 23 year-old Hispanic male with OHT at age of 14 for myocarditis related cardiomyopathy underwent routine surveillance left and right heart catheterization which demonstrated 95% trifurcation stenosis of the distal left main coronary artery (LMCA), ostial left circumflex (LCX) and left anterior descending artery (LAD) unresponsive to intracoronary nitroglycerin. He had previous evidence of CAV, requiring drug eluting stent to a LCX lesion. Biopsy results showed grade 1R mild acute cellular rejection at that time. Echocardiography demonstrated normal left ventricular function and the patient reported no symptoms.

The patient had been on aspirin and clopidogrel and received a loading dose of clopidogrel prior to the procedure. After femoral access the patient was loaded with bivalirudin followed by an infusion. Given the complexity of the disease ventricular support with a 2.5 L/min Impella® was placed via a 13 Fr left femoral arterial sheath and a 6 Fr right femoral arterial sheath was placed for the intervention. A Judkins® left 3.5 guide catheter was used to engaged the LMCA. A 3.0 x 12mm EMERGE® balloon was used to dilate the LMCA and proximal left circumflex lesions. A 3.0 x 20mm Promus PREMIER® DES was deployed from the ostial LMCA to the proximal LCX, overlapping with the previously implanted circumflex stent. Post dilation was performed with a 4.0 x 14mm non compliant Quantum Apex® balloon in the LCX. A 2.0 x 8mm balloon was used in the LMCA to dilate the stent struts to access the LAD. A reverse mini crush technique was used to perform T-stenting with a 3.0 x 8mm Promus PREMIER® DES in the ostial LAD. Post-dilation of both stents was performed with kissing balloon inflation with two 3.0mm balloons. Intravascular ultrasound demonstrated a change in the minimal luminal area in the LMCA from 4.8mm² to 12.8mm², with evidence of good expansion and apposition of the deployed stent. Minimum luminal area in the LCX was measured at 10mm². No immediate or short-term complications were experienced. The 2.5 L/min Impella® was weaned and removed at the end of the case and the patient was discharged the following day without any complications noted. The patient 3 months out from procedure continues to do well with no complaints.

Case 2:

A 27 year old Caucasian male with OHT at age 16 for dilated cardiomyopathy, presented with angina on exertion and underwent left and right heart catheterization which demonstrated ostial LM 90% stenosis, 90% proximal LAD stenosis and 70% proximal LCX stenosis. Biopsy results showed grade 1R mild acute cellular rejection and echocardiography demonstrated normal left ventricular function.

The patient was started on dual antiplatelet therapy prior to the procedure. After right femoral arterial access, heparin bolus was
Table 1: patient demographics and outcomes

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Race</th>
<th>Age at OHT</th>
<th>Symptoms</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>Male</td>
<td>Hispanic</td>
<td>14</td>
<td>Screening</td>
<td>3 months with no complaints</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>Male</td>
<td>Caucasian</td>
<td>16</td>
<td>Angina</td>
<td>Repeat OHT after 4 years</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>Female</td>
<td>African-American</td>
<td>14</td>
<td>Syncope</td>
<td>1 year with no recurrence</td>
</tr>
</tbody>
</table>

OHT - orthotopic heart transplantation

given. A 7 Fr angioplasty sheath was placed for the intervention. A 7Fr Judkins® left 3.5 guiding catheter was used to intervene on the ostial LMCA lesion. A 2.5 x 8mm Abbott Vascular VOYAGER® balloon was used to dilate the lesion followed by deployment of a 3.0 x 8mm Abbott XIENCE® DES. Post-dilation was performed with a 3.5 x 8mm Abbott Vascular VOYAGER® NC balloon with good result. Using the same Judkins® left 3.5 guiding catheter, the proximal LAD lesion was treated with a 3.0 x 8mm Abbott XIENCE® DES followed by a second 3.0 x 8mm DES more distally in the same vessel. The proximal angulation of the LAD origin precluded the use of a longer stent; hence two 8mm stents were used to cover the lesion. The proximal LCX lesion was treated using the same Judkins® catheter, with deployment of a 3.0 x 12mm Abbott XIENCE® DES. IVUS performed at the end of the procedure demonstrated good apposition of the LMCA and LAD stents. No complications were experienced following the procedure. On follow-up, repeat angiography demonstrated progression of the CAV, requiring repeat intervention on the proximal LAD lesion at 2 and 3 years following the initial procedure. The LMCA remained patent and the patient underwent repeat OHT at 4 years after the initial LMCA PCI, and is currently doing well with no complaints.

Case 3:
A 26 year old African-American female with OHT at age 14 for malignant ventricular arrhythmias and cardiomyopathy, underwent left and right heart catheterization following a syncopal episode. Angiography demonstrated a 95% ostial LMCA stenosis. Biopsy results did not show evidence of acute cellular rejection. The patient was started on aspirin and loaded with clopidogrel prior to the planned PCI. Right femoral access was obtained with placement of a 6 Fr angioplasty sheath. Left femoral artery access was obtained and upsized to a 13 Fr sheath for insertion of a 2.5L/min Impella®. The ostial LMCA lesion was pre-dilated with a 3.0 x 12mm Boston Scientific APEX® balloon, followed by implantation of a 4.0 x 12mm Boston Scientific Promus Element Plus® DES. Post-dilation of the stent was performed with a 5 x 12mm Boston Scientific NC Quantum Apex® balloon. Excellent angiographic results were achieved. IVUS showed a MLA of 13.5mm² following stent deployment, with good apposition. On repeat angiography, the LMCA remains patent at one year follow-up. The patient has no complaints or symptoms.

Discussion
CAV is seen in patients following OHT and is a major cause of morbidity and mortality. According to the International Society for Heart and Lung Transplant, incidence rates in transplant recipients are 8% by the first year, and 50% by 10 years post OHT. CAV accounts for 20% and 14% of deaths in the 18-39 and 40-59 age groups respectively, after the first year following heart transplantation. Symptoms typically are not reliable because of denervation associated with transplantation; therefore the diagnosis is usually made on routine surveillance coronary angiography. Treatment options include aggressive medical management and risk factor modification, as traditional risk factors associated with coronary artery disease appear to play a role in CAV as well. Options for revascularization are coronary artery bypass or percutaneous intervention, each presenting its own pitfalls. Frequently, the diffuse nature of the vasculopathy and vessel thickening precludes bypass grafting, while percutaneous coronary intervention has been shown to have higher rates of in-stent restenosis, target vessel revascularization, myocardial infarction and death as compared to non-transplant recipients.

The data on management of unprotected LMCA lesions in OHT patients with CAV is sparse, but review of case reports and series, present PCI as a viable option, being safe and reasonably effective. As more pediatric patients with OHT reach adulthood, the problem of revascularization will pose a great challenge. With LMCA involvement, the options include surgical revascularization and percutaneous revascularization. Surgical revascularization with coronary artery bypass grafting would require a repeat sternotomy in a young patient, increasing the complexity and morbidity involved with the surgery. Given the young age of these patients, definitive treatment of CAV will usually involve repeat OHT. Having undergone two sternotomies already, the prospect of a third for the repeat OHT is not ideal. With the percutaneous approach, the issue of dual antiplatelet therapy arises. These patients receiving a DES in the LMCA will presumably require long term DAPT and as these patients approach the time for repeat OHT, DAPT will likely complicate the perioperative period. The morbidity involved with perioperative and postoperative bleeding becomes a concern.

In our series of young patients with CAV involving the LMCA, we demonstrate PCI as a viable option for palliating symptoms and coronary disease while repeat OHT is awaited. We have three very different presentations for similar pathology, i.e. syncope, angina and routine screening. At our institution, the decision in each case was made as part of a collaborative effort amongst the interventional cardiologists, cardiothoracic surgeons and the heart transplant team. More research in this area will be necessary before any recommendations for the optimal management of these patients can be determined.

Statement of ethical publishing
The authors agree to abide by the requirements of the “Statement of publishing ethics of the International Cardiovasular Forum Journal.”

Funding:
No grant support.

Conflict of interest:
No conflicts of interest to be disclosed.
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