

Iatrogenic Coronary Artery Compromise Post Non-Coronary Cardiac Surgery in Patients With Normal Coronaries

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ABSTRACT

Background: Unexpected events in cardiac surgery may increase morbidity and mortality. We present rare complications related to coronary arteries in non-coronary cardiac surgery in adults and pediatrics.

Patients and Methods: We retrospectively reviewed our surgical left-sided valve procedures and aortic root reconstruction for patients with documented coronary ostial injury or left circumflex artery (LCX) between January 2012 and December 2019.

Preoperative echocardiography was the standard investigation for all cases and other specific work ups were ordered, according to each case. Management by surgical or non-surgical intervention was planned, according to each complication. Postoperative hemodynamics and mortality rate were the outcomes of interest.

Results: Seven patients were found to have coronary artery compromise post left-sided valve procedures and aortic root reconstruction in adults and children. The details are shown in Table 1. The complications were in 2 patients post-mitral valve (MV) repair, 3 patients post-aortic (AV) replacement, 2 pediatric patients, 1 post-aortic homograft, and the other post-repair of anomalous single coronary arising from the pulmonary artery (ASCAPA). Six patients were hemodynamically unstable. Five patients had intraoperative ischemic changes on electrocardiogram and echocardiography, while ventricular arrhythmias were documented in 3 patients. Two patients were treated with percutaneous coronary intervention to LCX and right coronary artery (RCA), while 4 patients required immediate surgery to graft the obtuse marginal branch of the LCX artery (1) and RCA (3). No revision to valvular procedure was done. With the exception of one, all patients survived.

Conclusion: A high index of suspicion is required to diagnose and rescue coronary complications post-valvular surgery and aortic root reconstruction.

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INTRODUCTION

The close proximity of the coronary ostia to the aortic valve and the left circumflex (LCX) artery to the posterior mitral valve (MV) annulus make them susceptible to injury during AV and MV surgery [Pillai 2004; Mantilla 2004; Funada 2006]. Coronary ostial relocation, especially in pediatrics, requires meticulous technique to avoid ischemia. Coronary injury can jeopardize the myocardium and expose patients to a considerable risk of morbidity and mortality and several cases of this complication have been reported in the literature [Mantilla 2004; Funada 2006; Folkmann 2014; Meursing 2006].

In this article, targeted patient population includes adult and pediatric patients with iatrogenic coronary artery injuries post-non-coronary cardiac surgery. Clinical setting and controversies in management are discussed. Early identification of these complications is the primary objective and selection of the appropriate surgical strategy is our secondary goal.

MATERIALS AND METHODS

We retrospectively analyzed all patients who underwent AV and MV surgery and aortic root reconstruction in our hospital between January 2012 and December 2019. Patients with intraoperative and postoperative complicated course who required intraoperative surgical intervention or postoperative coronary angiography (CAG) were identified.

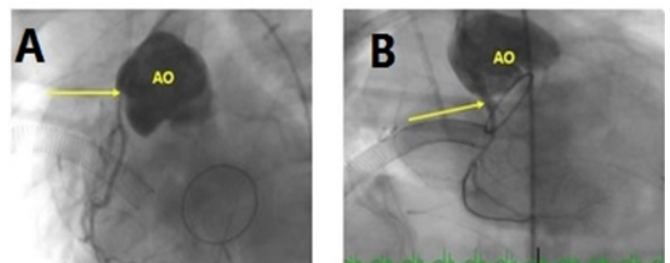


Figure 1. A) Proximal RCA stenosis after aortic root surgery (yellow arrow). B) Same patient after RCA stenting (yellow arrow). AO: aorta.

Overview of patients reported with coronary artery injury post aortic and mitral valve and root surgery (N = 7)

Case	Age (years)	Sex	Preop EF	Surgery	Post ECG	Intraop. transeso Echo hypo kinesia	Procedure
1	79	F	45	AVR+MV repair	Postero inferior ST depression	Lateral	Vein to Obtuse marginal
2	69	M	40	AVR	Inferior ST depression	Inferior	Vein to RCA
3	47	F	55	AVR	Inferior ST depression	Inferior	Vein to RCA
4	35	F	65	MV repair minimally invasive	Posterior ST depression	Posterior	Stent to LCX
5	13	M	60	AVR	Anterior ST depression	Anterior	LIMA to LAD
6	1	M	65	aortic homograft +MVR	Diffuse ST elevation	Not done	RCA stent
7	Newborn	M	65	ASCAPA transfer	Ventricular fibrillation	Not done	Extension re-anastomosis

The variables extracted in the Table included demographic data, type of surgery, preoperative left ventricle ejection fraction, intraoperative electrocardiography (ECG), echocardiographic findings and treatment method. The study was approved by the ethical committee at our institution.

RESULTS

Out of 312 patients who underwent AV, MV and root surgery, 7 patients (2.2%) had coronary injury. Six cases were diagnosed intraoperatively by hemodynamic instability and ischaemic changes in ECG. Wall motion abnormality in transesophageal echocardiography was detected in 5 patients. Three patients required intraoperative vein graft revascularization to RCA (in two patient) and to obtuse marginal branch of the circumflex in one. One child required left internal mammary artery to the left anterior descending artery. One pediatric patient was diagnosed intraoperatively and taken to the catheterization laboratory and underwent stent to RCA. Two paediatric patients required extracorporeal membrane oxygenator. One patient was diagnosed postoperatively and treated with stent to LCX. A one-year-old infant with congenital heart disease with severe aortic valve stenosis, coarctation of aorta, mitral stenosis underwent balloon dilatation for both the coarctation and the stenotic aortic valve early in life followed by open valvotomy for the aortic and mitral valves at the age of 8 months. Later on, he had severe aortic insufficiency severe mitral stenosis. The patient was accepted for a high-risk operation of aortic root replacement by aortic homograft after Konno type enlargement. Coronary button technique was straightforward, regarding left main coronary artery transfer but there was bleeding from button to hole anastomosis of the right coronary artery and multiple stitches were taken to control then mechanical mitral valve replacement was performed. After 20 minutes of weaning off cardiopulmonary bypass, the heart developed ischemic changes, so the patient was placed on extracorporeal membrane oxygenator (ECMO) and transferred directly to the catheterization lab. Angiography showed ostial stenosis of RCA that successfully was stented. After stenting cardiac function dramatically improved, the patient was weaned from ECMO

support and discharged well (Figure 1). Failure to wean from CPB with persistent ventricular fibrillation was seen in a 13-year-old male after AVR by mechanical valve size 19 mm. Transesophageal echocardiography (TEE) revealed global hypokinetic left ventricle. Re-aortotomy showed no obvious complications of coronary ostia so the decision was to perform a left internal mammary artery (LIMA) graft to the left anterior descending artery (LAD) that rescued the patient with good recovery. A one-month-old male baby presented with severe biventricular dysfunction with suspicion of aberrant left coronary artery from pulmonary artery (ALCAPA). Multidetector computerized tomography (MDCT) angiography and aortic angiography revealed ASCAPA (Figure 2, 3). Cardiac surgery was done, but unfortunately the location of the single coronary ostium was posterior so it was difficult for translocation. Extension of the coronary artery was difficult and resulted in stretch causing severe myocardial ischaemia. The patient was unable to be weaned from CPB and was connected to an extra corporeal membrane oxygenator (ECMO), but unfortunately died 5 days later.

DISCUSSION

Coronary ostial stenosis is believed to occur in 1% to 5% following AVR procedures [Funada 2006]. Causes of coronary ostial occlusion post-AVR include proximity or inclusion in aortotomy suture, ostial thrombosis as traumatic consequence from an aortic retractor, direct ostial cardioplegia, calcium debris embolization, and partial direct occlusion by the device [Funada 2006]. Although coronary ostial stenosis after aortic root replacement has been reported for over 40 years, it remains a challenge that requires emergent management to save patients. Intraoperative transesophageal echocardiography (TEE) is essential in detecting perioperative complications, including changes in coronary blood flow and new regional wall motion abnormalities [Ender 2010]. We were obligated to do rescue CABG for all cases with compromised coronary artery after valve surgery as weaning from CPB was difficult. Coronary compromise was diagnosed by electrocardiographic and echocardiographic regional wall motion in intraoperative TEE. We did not



Figure 2. Aortic angiography showing "coronary less aortic root," typical of ASCAPA (anomalous origin of a single coronary artery from the pulmonary artery).

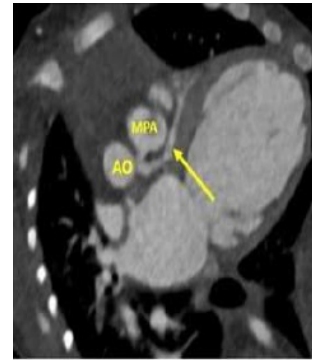


Figure 3. Multidetector computerized tomography (MDCT) of the same patient showing the ASCAPA (yellow arrow). MPA : main pulmonary artery.

reposition the valve device in any of our patients. Acute coronary complications of different valvular surgical procedures was diagnosed and treated in the cardiac catheterization laboratory in multiple reports [Mantilla 2004; Ziakas 2010; Bernelli 2012].

Regarding mitral LCX injury post-MV, Hiltrop found 44 cases in world literature of mitral valve surgery-related LCX injury [Hiltrop 2017]. Left-dominant coronary circulation is at higher risk, due to the shortest distance between the LCX artery and MV [Meursing 2006]. Scarsini used intracoronary optical coherence tomography to identify the cause and mechanism of coronary flow impairment in a recent case series report [Scarsini 2020]. Alqahtani and colleagues reported suture-related distortion of the artery, causing subtotal occlusion of the circumflex coronary artery following mitral valve annuloplasty [Alqahtani 2017]. Bernelli and colleagues did percutaneous coronary intervention as treatment for iatrogenic coronary ostial stenosis after aortic root surgery [Bernelli 2012]. Six of our cases were diagnosed intraoperatively and were hemodynamically unstable to go to the catheterization lab and a diagnosis was made intraoperatively to save the patients. Anomalous origin of a single coronary artery from the pulmonary artery (ASCAPA) is a rare and potentially fatal malformation. It is rarer than anomalous left coronary artery from the pulmonary artery. Echocardiography is not helpful. CT angiography and cardiac catheterization are essential to make the diagnosis [Shetty 2015; Kawamura 2012]. Coronary compromise post-aortic root reconstruction in adults is very rare, but is more often seen in the pediatric age group especially neonates because of the small size of the coronary arteries and the liability to stretch or compression. The diagnosis has to be made before leaving in the operating room. Diagnosis in the catheterization laboratory is reserved for relatively stable patients. Collaboration of the cardiac surgeons with cardiologist is crucial for diagnosis and management. All necessary investigations and interventions should be implemented in a swift manner to minimize myocardial damage. The main limitation of this study is the small sample size and short follow-up. Multicenter studies on large number of cases are needed for generalizability to other populations and to conclude implications for clinicians and policymakers.

CONCLUSION

Post cardiac surgery, hemodynamic instability, electrocardiographic and echocardiographic changes and requirement of high inotropes should alert the surgeon for a possibility of coronary injury. A high index of suspicion is essential for early diagnosis especially post valvular and aortic root procedures. Overlooking these major complications will put the patient at a higher risk for myocardial damage. Confirming the diagnosis by coronary angiogram and intervention is indicated in stable patients. Unstable patients require rescue coronary bypass without angiogram to save their lives.

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