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Coronary artery grafting in infants

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Abstract

Background

Coronary artery bypass grafting (CABG) with cardiac vale repair is an uncommon surgery in infants. CABG is technically demanding in infants due to the small size not only of the coronary arteries but also the potential graft arteries. The short and long-term outcome of surgery is not known and thus has largely been avoided.

Results

We report the case histories of two infants in whom CABG was undertaken successfully as a life-saving measure. Case 1: This infant needed an arterial switch operation after which the right coronary artery (RCA) was stenosed resulting in low cardiac output. After the right internal mammary artery (RIMA) was used to anastamose the RCA, the hemodynamic status improved drastically. Case 2: This infant underwent surgical correction for Anomalous Left Coronary Artery from Pulmonary Artery (ALCAPA). Postoperatively, she was in low cardiac output. She was found to have an occluded left coronary artery and mitral regurgitation (MR). After she underwent left internal mammary artery (LIMA) to Left Anterior Descending (LAD) anastamosis and mitral valve repair, the clinical condition improved dramatically.

Conclusion

CABG is an uncommon operation in infants. This surgery is technically difficult. The long term results are not known and there are very few reports

for the same. Though such an operation is best avoided, it can be used as a desperate life saving measure.

Introduction

Coronary artery bypass graft (CABG) surgery is technically difficult in infancy due to the small size not only of the coronary arteries but also the potential graft arteries. The short and long-term outcome of surgery can be unpredictable, and thus has largely been avoided. We report the case histories of two infants in whom coronary artery grafting was undertaken successfully as a life-saving measure.

Case 1

A neonate (three day old, 2.2 kilogram) investigated for cyanosis at birth was found to have transposition of great arteries (TGA), intact ventricular septum and restrictive patent foramen ovale. Balloon atrial septostomy (four day old) was done, saturations improved and the baby was taken for urgent arterial switch operation (ASO) on the sixth day of life (1-10-06). Intraoperatively TGA was confirmed, and ASO was performed under cardiopulmonary bypass (CPB) with both antegrade and retrograde cardioplegia. The aorta and pulmonary arteries were divided after accurate measurement to prevent any tension along the anastamotic lines. The coronary buttons were transferred to the root of the divided Pulmonary artery (PA) after which the divided distal aorta was brought below the PA confluence (Lecompte manoeuvre) for anastamosis with the PA (neoaorta). The PA defect resulting from dissection of coronary buttons was then reconstructed using a trouser shaped pericardial patch. The heart came off CPB easily after which the chest was closed and baby shifted to intensive care. The postoperative hemodynamics were excellent with normal electrocardiogram (ECG), normal troponin levels and echocardiography (ECHO) showing good ventricular function. He was discharged on the 9th postoperative day. During follow up (December 2006), he was investigated for found to have respiratory symptoms. Chest Xray showed significant cardiomegaly, ECG showed ischemic changes in the inferior leads. ECHO showed significantly impaired left ventricular (LV) function. Captopril, Digoxin, Frusemide and Spironolactone were started for cardiac failure. During cardiac catheterization (December 2006), no forward flow was seen in the right coronary artery (RCA). However there was faint visualization of the RCA, filling from left coronary artery (LCA) collaterals. Though the need for surgical intervention was obvious, no surgery could be done immediately, as the parents refused to give consent. During subsequent follow up, the cardiac failure worsened, the dosages of the medications had to be increased. At this stage, parental consent was obtained and we decided to perform surgical revascularization. On 15th July 2007, Myocardial radionucleide scan (99m- Technetium- Tetrofosmin Myocardial Perfusion Scintigraphy) showed perfusion deficits in the inferior and basal segments suggesting impaired coronary perfusion. After detailed deliberations and discussions it was decided to perform an off pump coronary artery grafting for the RCA using right internal mammary artery (RIMA). Considering the

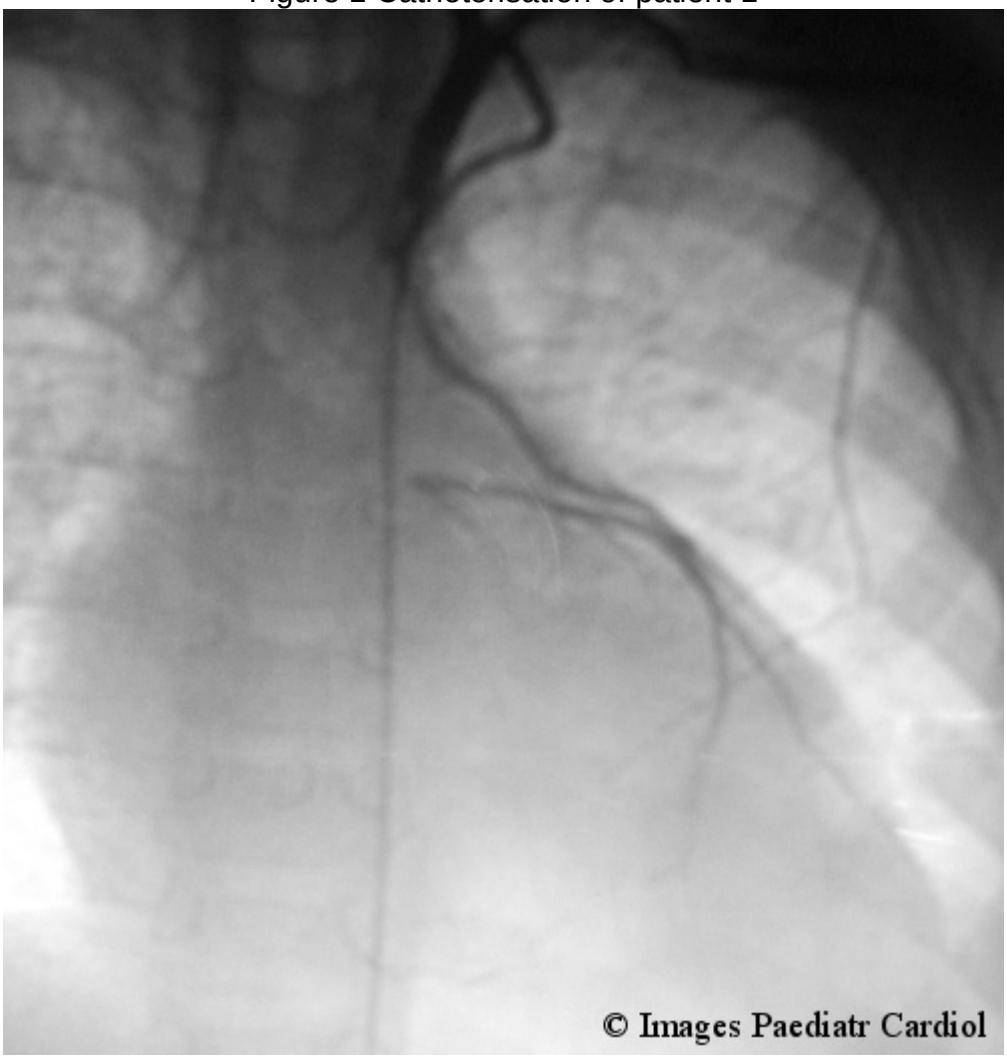
difficulty of weaning a poor ventricle off CPB, it was decided to perform an off pump CABG. Intraoperatively, the RIMA was found to be barely 1.5 mm size while the RCA was only 1 mm size. The RIMA was dissected using diathermy and had good flow. The RCA was stabilized between stay sutures and opened for grafting to RIMA using 8-0 prolene sutures. The postoperative course was uneventful and the baby was discharged. Postoperative ECHO done one month postoperatively showed good flow across the RIMA to RCA anastamosis. At two years follow up the baby has optimum weight (7.8 kilogram), is active, has no ECG changes and is not on any medication. ECHO shows normal LV dimensions and good LV function. Post operative cardiac catheterization could not be done as parental consent was not given.

Case 2

A 3 month baby (2.6 kilogram) with dysponea was found to have severe LV dysfunction with mild mitral regurgitation (MR) in ECHO. Cardiac catheterization (5-11-05) showed late filling of left coronary artery (LCA) from left pulmonary artery (LPA). Surgical correction of Anamolous Left Coronary Artery from Pulmonary Artery (ALCAPA) was done on cardiopulmonary bypass (CPB) (10/12/05). LCA origin was cut off with a liberal button of main pulmonary artery (MPA) and dissected to allow a tensionless transfer to the aorta. LCA was anastamosed to the posterolateral aspect of the aorta. After reconstruction of the MPA, CPB was discontinued with significant inotropic supports. Postoperatively she continued to have poor myocardial function and needed high dose infusion of dopamine, dobutamine and adrenaline. It was not possible to wean her off the ventilator. ECHO showed significant MR, severe LV hypokinesia. ECG showed ischemia in the lateral leads. Aortic root injection showed no opacification of LCA. Hence she was scheduled for revascularization of the left coronary system and MV repair. Intraoperatively (23/12/05), the ventricles were barely contracting, much dilated and the LA appeared distended. The left main coronary artery (LMCA) was 1 mm in diameter and 8mm long. There was a slight narrowing of the LMCA just distal to its implantation to the aorta. Even after full mobilization, the left subclavian artery (SCA) was barely 1 cm long and rudimentary. Hence SCA could not be used either as a free or a pedicled graft. Since, the left internal mammary artery (LIMA) was 1.5 mm size and had good pulsations, LIMA was harvested. Intraoperatively, right atrium (RA) opened followed by a ‘J’ shaped septal incision to expose the MV. The posterior mitral leaflet (PML) was floppy and rudimentary. The anterior mitral leaflet (AML) appeared to be normal. The MR was due to annular dilation (size 16 Hegar dilator). Posterior MV annuloplasty was done using pledgetted 5-0 prolene. The posterior annulus was reinforced and shortened by two pairs of continuous sutures coming to the centre of the PML from opposite commissures. Since the expected MV annulus diameter for this baby was 11 mm both pairs of the sutures were tightened and tied off over a size 12 Hegar dilator. Testing the MV on table using saline injection, showed no MR. The LAD was identified and LIMA anastamosed to the LAD using 7-0 prolene sutures. Inter-atrial septum and RA closed, heart deaired and cross clamp released. Soon sinus rhythm resumed and CPB was discontinued effortlessly; however dobutamine was infused at 4 micrograms /kilogram /minute.

Postoperatively, ECHO showed a significant improvement in LV function and no MR. The postoperative course was uneventful and she was eventually discharged from the hospital on digoxin and frusemide. At three years follow up, she has gained weight (9.6 kilogram), ECHO shows good left ventricular function and no MR. These findings have been confirmed by cardiac catheterization (21-07-08), (Figure 1). Her medication was stopped completely four months ago, and she is doing well.

Figure 1 Catheterisation of patient 1



Discussion

Coronary revascularization is an uncommon surgery in an infant. Coronary revascularization along with cardiac valve repair is also an unusual surgery in infants.[1] However coronary revascularization is indicated in babies who need ASO or surgical correction for coronary abnormalities. The coronary arteries are very small and delicate and re-implantation of these arteries or constructing an anastamosis for these arteries becomes technically demanding. These situations may come up immediately postoperatively or in the later years during follow up.[3,4]

During the initial surgical correction itself, care was taken to avoid any tension in the newly implanted coronary arteries. In the first case, the arteries were

checked after repositioning; and they were found to be free from any tension. After the re implantation of the left coronary artery button to the aorta (case 2) there was no tug on the artery. However with fibrosis in the postoperative period, these arteries can get pulled or deformed causing narrowing. Also, cardiac dilatation due to congestive cardiac failure also may have led to stretching of the artery causing stenosis.

Bergoënd et al have stated that provided that the left main coronary artery bifurcation was not involved in the stenotic process, surgical arterioplasty of the main coronary trunks led to good functional and anatomic midterm results.[4] In both infants from our study, the main coronary trunks were not visualised during angiography. Also, dissection of the main coronary arteries at the aortic root is very difficult due to dense adhesions from previous surgery. In case 1, intraoperatively, the RCA was identified in the anterior atrioventricular groove and grafted. In case 2, there was a slight narrowing of the LMCA just distal to its implantation to the aorta. In this situation it was decided to graft the LIMA to LAD so that it could supply the entire left coronary system. These infants have benefitted as their cardiac function improved (clinically and by ECHO), ECG changes reverted, they have put on weight and are free from medication.

Subclavian artery has been reportedly used as graft in an infant for reconstruction of LMCA.[5] In both cases the SCA was found to be unsuitable for grafting as it was short and rudimentary.

Dissection of a coronary artery in a redo open heart case can be a daunting task even in adults. CPB further increases the risk of bleeding and low cardiac output. In the first baby (post ASO), it was technically difficult to cannulate the aorta (for CPB) as the PA lies anterior to the aorta. Also weaning off a sick LV from CPB was avoided by doing an off pump CABG. In the second baby CPB had to be instituted for mitral valve repair along with CABG. We had to wait two years before consent was given for cardiac catheterization, that too in only one patient.

Conclusion

Coronary revascularization is uncommon in infants. There are reports are of CABG in bigger children and in adults with congenital cardio-vascular lesions.[2,3,6] Small, delicate arteries, non availability of good calibre conduits and co existing cardiac failure makes surgical revascularization extremely challenging.[3,4,5] However in these two infants revascularization was done as a desperate life saving measure. Though long term results are not known, this surgery did improve the hemodynamic parameters and increased the life span of these infants. With increasing number of surgical corrections for coronary anomalies in infants, the need for coronary revascularization is likely to increase.

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