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Hybrid Cardiac Revascularisation Surgery

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ABSTRACT

Currently, 3 methods of myocardial revascularisation are available for the treatment of coronary artery disease: i) coronary artery bypass grafting (CABG); ii) percutaneous transluminal coronary angiography (PTCA), and iii) transmyocardial laser revascularisation (TMR). Until recently, these procedures were performed exclusive to one another.

We report 2 cases of minimally invasive direct coronary artery bypass grafting with subsequent PTCA, and 1 case of staged PTCA followed by TMR performed at our institution. We discuss the role of hybrid procedures in the current era of treatment of ischaemic heart disease.

Keywords: hybrid surgery; minimally invasive direct coronary artery bypass; transmyocardial laser revascularisation, percutaneous transluminal coronary angioplasty

INTRODUCTION

Methods of treatment for ischaemic heart disease presently available are coronary artery bypass grafting (CABG), percutaneous transluminal coronary angioplasty (PTCA) with or without stenting and more recently transmyocardial laser revascularisation (TMR). Until recently, these procedures were performed independent of one another. If CABG was to be performed then it would limit the value in performing PTCA on the same patient. However, with the recent advent of minimally invasive direct coronary artery bypass (MIDCAB) to establish left internal mammary artery (LIMA) to left anterior descending (LAD) grafting, a hybrid approach of MIDCAB and PTCA to the other vessels appears to be less invasive compared to conventional CABG. Further, combined PTCA and TMR appears to be another viable hybrid procedure.

We report our early experiences with hybrid procedures of percutaneous transluminal coronary angioplasty (PTCA) integrated with other forms of myocardial revascularisation. These include 2 cases of simultaneous minimally invasive direct coronary artery bypass (MIDCAB) with PTCA and 1 case of staged PTCA followed by transmyocardial laser revascularisation (TMR).

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CASE REPORTS

Case 1

A 50-year-old Chinese man with a history of hypertension and hyperlipidaemia presented with stable angina. Cardiac catheterisation revealed total occlusion of the LAD and a discrete 70% occlusion of the mid-RCA. PTCA of the LAD was unsuccessful, and as the patient was not willing to undergo conventional "on-pump" coronary artery bypass grafting (CABG), MIDCAB was performed through a left anterior small thoracotomy in the 4th intercostal space and the left internal mammary artery (LIMA) was anastomosed to the LAD using the "octopus" (Medtronic Inc) to stabilise the site of anastomosis. The patient was extubated in the intensive care unit (ICU) 3 hours post-operatively and then transferred to the cardiac catheterisation lab where angiographic visualisation of the anastomosis site revealed a patent LIMA to LAD graft. PTCA and stenting was performed to the distal RCA. Recovery was uneventful with an ICU stay of 2 days, and patient was discharged on the sixth post-operative day.

Case 2

A 77-year-old Chinese lady with a history of peptic ulcers and a 9 cm abdominal aortic aneurysm (AAA) presented with lethargy, malaise and shortness of breath. Cardiac catheterisation showed triple vessel disease and mild left ventricular (LV) hypokinesia, with 90% calcific long segment stenosis of the LAD and 90% stenosis of the RCA. Abdominal aortogram showed a saccular infra-renal aneurysm. MIDCAB was performed through a left anterior small thoracotomy incision in the fourth intercostal space. The LIMA was harvested and anastomosed to the LAD with the aid of the "octopus" stabiliser (Medtronic, Inc). The patient was extubated 5 hours post-operatively in the ICU before being transferred to the cardiac catheterisation lab where a patent LIMA to LAD graft was visualised angiographically. PTCA and stenting was performed

to the RCA lesion. Post-operatively the patient had a small pleural effusion and fever. The patient was discharged on the eleventh post-operative day after an ICU stay of four days. One month post-operatively, the patient was readmitted and underwent successful repair of AAA.

Case 3

A 72-year-old Malay lady with a history of diabetes and hypertension presented with unstable angina. Electrocardiography revealed ST segment depression in anterior leads which was reversible. Cardiac catheterisation showed diffuse vessel disease in the LAD and circumflex artery which was not amenable to PTCA or surgery, and discrete 80% stenosis of the RCA. Pre-operative Dobutamine stress echocardiography revealed inferolateral hypokinesia at rest, with inducible ischaemia in multiple territories, and an LV ejection fraction of 65%. The patient was offered conventional CABG with TMR or staged PTCA followed by TMR of which she chose the latter. The patient underwent PTCA and stenting of the RCA and one month later TMR was performed via a left anterior thoracotomy through the fourth intercostal space. Using the High Power 800 watt CO_2 Laser (PLC Medical System), 21 channels were created in the anterior and lateral wall of the LV, which were confirmed by transesophageal echocardiography. The patient had an uneventful post-operative period with an ICU stay of two days, and was discharged on the thirteenth post-operative day. Post-operatively the patient had no angina or shortness of breath.

Comments

Besides medical therapy, three methods of treating ischaemic heart disease are available: i) CABG, ii) PTCA and more recently, iii) TMR. In the past, these procedures have been performed exclusively of one another. If CABG is performed there is little indication for PTCA to vessels on the same patient. However more recently, hybrid procedures combining PTCA with MIDCAB or TMR are becoming increasingly feasible. With MIDCAB becoming an established procedure allowing for good access for LIMA to LAD anastomosis, PTCA can be applied in the revascularisation of the right coronary artery and circumflex territory. Such integrated procedures in cardiac surgery is a new trend with little published in the literature.

Each of these three forms of medical therapy have their own advantages and disadvantages. PTCA has the advantage of being a minimally traumatic procedure with low morbidity, however its practice is limited to only certain vessel lesions. It is not ideal for ostial lesions, long segment stenosis, or chronic total occlusions. CABG on the other hand has the advantages of more definitive long term results, however incorporates the significant morbidity of the median sternotomy incision[1-6] and cardiopulmonary bypass (CPB)[8-11]. MIDCAB, which incorporates the benefits of CABG without the adverse effects of CPB and the median sternotomy incision. However it is limited to LIMA to LAD grafts[13-16], and has the disadvantage of not being able to reach the Cx vessel. For these reasons, combining the procedures appear to be an ideal compromise. MIDCAB combined with PTCA has the advantages of both lower morbidity of both the PTCA and minimally incision, as well as the high rate of patency for LIMA to LAD anastomosis. Angilini[17] reported hybrid procedures on 6 patients, 4 with staged procedures and 2 with simultaneous procedures. One patient undergoing simultaneous MIDCAB with PTCA, required re-operation due to acute stent thrombosis, however all others had successful procedure with all patients having a symptom free post-operative recovery period. Calafiore[14] reported 11 cases of staged MIDCAB with PTCA procedures in his series of 343 patients undergoing the LAST operation with a post-operative mortality of 2 patients. One patient had pericardial tamponade 10 days post-operatively and 7 days post-stent PTCA, while the other patient had acute heart failure 18 days post-operatively while undergoing PTCA to the circumflex artery. Both patients however had a patent LIMA to LAD graft as seen angiographically.

TMR is one of the newer methods of treating ischaemic heart disease and allows for revascularisation of territories on the heart which is not amenable to PTCA or CABG. Although there have been encouraging clinical improvement in patients[18-20], the mechanism remains unclear and channel patency has been disputed[21-22]. However, combining TMR and PTCA incorporates the benefits of minimal morbidity due to minimal access to the hearts and the avoidance of CPB, as well as the benefits of PTCA to amenable vessels and TMR to vessel regions which are not amenable to other forms of therapy. Such a hybrid has been described by Herz-Zentrum Bodensee, Switzerland[23,24] in their series of 268 TMR treated patients, of which 12 patients underwent integrated TMR and PTCA. Initially, simultaneous TMR followed by PTCA on the same day was performed, but this resulted in immediate complications due to occlusion of the PTCA vessel. The sequence of the procedure was then reversed with PTCA performed 4 to 5 days after TMR with better results. However they still reported a post-operative mortality of 17%, which was attributed to poor patient pre-operative conditions.

The advantages of these various hybrid procedure is obvious, with increased benefit for younger patients in whom re-operation is a likelihood, and in older patients in whom CPB may be unsuitable. With the coming of age of hybrid procedures, physicians are no longer limited to treating coronary artery disease with either surgery or PTCA exclusively. They may now combine the advantages of both procedures to benefit patients.

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