Midterm Results Of Off-Pump Coronary Artery Bypass Surgery In Indian Patients
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Abstract
Aims
Off-Pump coronary artery bypass surgery (OPCAB) is becoming popular especially in developing countries because of cost considerations. The safety of this technique has been proved by multiple studies. However there is a lurking doubt about the mid and long term results of this technique. We are presenting the three-year results of patients who underwent OPCAB surgery in our institution.

Methods and Results
Eighty patients underwent OPCAB surgery between March and December 2003. The status of all these patients was reviewed at the end of three years. The results were analyzed. One patient died in the postoperative period. Four of the seventy-nine patients were dead at the end of three years. Of the remaining 75 patients, 70(93%) are free from angina, 71(95%) are free from hospital re-admissions, 56(75%) are having a good quality of life and one patient underwent redo coronary surgery. No patient needed percutaneous interventions during this period. Based on their experience, 74(98.5%) patients are happy to recommend this mode of treatment to others with similar problem.

Conclusions
Our results suggest that OPCAB surgery yields satisfactory midterm results, which is comparable to that of on-pump surgery in the literature.

INTRODUCTION
Ageing population, increasing number of high-risk patients with multiple co morbidities, competition from angioplasty, developments in stabilization techniques and anesthesia have all led to growing popularity of off-pump coronary artery bypass (OPCAB). Several reports are available to document the safety of OPCAB in all subsets of patients. This technique is being adopted in a large scale in developing countries like India mainly because of the cost saving. However, there is a lurking doubt about the mid and long term results of OPCAB. This paper describes our 3-year results of OPCAB.

PATIENTS AND METHODS
PATIENTS
From March 2003 to December 2003, eighty patients were revascularised by OPCAB technique through median sternotomy by a single surgeon (A.R.R) with a prior experience of more than 400 multivessel OPCAB procedures. Almost all patients coming for revascularisation were approached with the idea of performing OPCAB and the final decision was made after inspection of target vessels. During this period only 14 patients underwent isolated primary coronary artery bypass grafting (CABG) using cardiopulmonary bypass (CPB). There was no conversion from OPCAB to on-pump technique. The preoperative and postoperative profiles of these patients are detailed in Tables 1 and 2.
METHODS
The OPCAB procedure was done using Octopus 3 or 4 stabilizing devices (Medtronic Inc. Minneapolis, MN, USA). Intracoronary shunts were used routinely. Heparin was administered at a dose of 2 mg /kg and Protamine neutralization was done at half the calculated dosage. All patients received 300mg clopidogrel and 300 mg Aspirin within 6 hours of shifting to postoperative ward. Aprotinin was not used in any patient. At the time of discharge most patients were sent home with a prescription of four drugs viz: antiplatelets, statins, beta-blockers and ACE inhibitors. The patient's physician or cardiologist was taking care of the routine periodic follow up and they were examined at our outpatient clinic annually. At the completion of three years after surgery, a questionnaire (Table 3) was given to every patient at the time of third annual follow up. These responses and the findings from third annual follow up examination form the basis of this analysis.
DEFINITION OF TERMS

Mortality included death due to any cause. Cerebrovascular accident (CVA) was defined as focal or global neurological deficit lasting for <24 hrs (Transient ischemic attacks-TIA) or ≥ 24 hrs (Stroke). AMI was defined as enzymatic elevation, new Q waves, and new akinetic segments in echocardiogram.

RESULTS

SURVIVAL

One patient died in the postoperative period due to vein branch blow out. Seventy-nine patients went home alive. Follow-up data are available for all 79 patients. Four persons died in the follow up period. Out of these four patients one died of malignancy. One patient died of acute coronary syndrome after 2 years. Another patient suffered sudden death at the end of two and a half years, which should be classified as cardiac death. The cause of death in the fourth patient was dense stroke due to bilateral carotid stenosis, which was found out during the time of surgery itself. She had moderate mitral regurgitation also. She had two grafts off-pump and was living happily for two years and eight months when she developed this fatal stroke. Seventy-five
patients are alive till date giving a survival of 93.75% at 3-year follow-up.

**EVENT FREE SURVIVAL**

Among the seventy-five patients whose follow-up details are available, one patient was readmitted for acute coronary insufficiency in another hospital. He responded to medical management and is symptom free now. Another patient complained of significant angina. He was restudied at the end of one year and found to have stenosis of two of the three grafts. He underwent redo-CABG with two vein grafts on-pump and is symptom free now. Seventy patients are free from angina at three years (93%). Four patients were readmitted in the hospital, two with coronary syndrome and two with stroke giving a freedom from hospitalization of 95% at three years. Out of the two patients with stroke one had severe carotid disease preoperatively and she died of massive stroke. The other patient had normal preoperative carotid Doppler and suffered a TIA. Another patient with preoperative carotid Doppler evidence of severe carotid disease is still free from any neurological events.

**LV FUNCTION**

All the patients had their ejection fraction (EF) measured preoperatively and annually postoperatively. Two patients who had normal EF preoperatively showed a fall in EF to 40% at third year follow-up without any clinical or electrocardiographic evidence of MI. All the other patients with normal function are maintaining the same. Among the nine patients with EF < 40%, two continue to have the same EF whereas the other seven patients showed improvement in EF. However the numbers are too small to make any conclusions from it.

**LIFESTYLE**

Sixty-four of the seventy-five patients (85%) claimed to be walking regularly. Forty-seven patients (65%) are enjoying satisfied sexual activity. Fiftysix patients (75%) are back to their job and earning. It is heartening to note that all have claimed to have stopped smoking. Only forty-four (58%) patients are taking all the four drugs prescribed regularly. This is understandable because most of the patients in this group are from the lower and lower middle income group and feel the cost of the medicine to be too high for regular life long adherence. Except the one patient who was readmitted with acute coronary syndrome, all the others expressed that they would recommend this operation to others with similar disease thus indicating the overall satisfaction level of the patients.

**TREADMILL TEST**

The results of third year treadmill test were available for seventy one patients. The four patients who did not have treadmill test include the two patients with recurrent angina and two with worsening ejection fraction. Seven patients had positive treadmill without angina. All of them could complete more than eight metabolic equivalents on the treadmill. Six out of these seven patients were diabetics. As they were happy with their activity levels, none agreed for any further evaluation.

**COMMENTS**

Myocardial revascularisation without CPB was supposed to reduce systemic inflammatory response, and myocardial injury related to cardioplegic arrest. Though OPCAB strategy may reduce perioperative morbidity and costs, it is uncertain whether the long-term outcome is similar to on pump CABG (ONCAB). Despite the well-known nature of diffuse coronary artery disease and smallness of coronary arteries, India is one of the countries with a high rate of OPCAB. So, the apprehension about mid and long term outcome with OPCAB in Indian patients is quite justified. We could not come across any report from this country about the mid term outcome of OPCAB.

Nathoe et al. in a muticenter randomized trial involving 139 patients on pump and 142 patients OPCAB compared the one year outcome of OPCAB and ONCAB. They were all low-risk patients. There was no difference in outcome. The rate of freedom from death, stroke, myocardial infarction and coronary reintervention was 90.6 percent ONCAB and 88 percent OPCAB. The only difference was a higher cost of $1839 in the ONCAB group. Calafiore et al. compared the early and late outcome in 1020 high-risk patients and found that the early outcome was better with OPCAB. The five-year freedom from cardiac death, acute myocardial infarction (AMI), AMI in grafted area and coronary reintervention were similar in both groups (90-95%). They found failure of revascularisation on grafted vessels to be slightly higher in the off-pump group thus demonstrating that off-pump strategy does not affect negatively the patency rate in the long term. Beaning et al. found in a follow-up of 27 11 months freedom from death 98.4%, freedom from reintervention 94.9%, freedom from AMI 97.6% and freedom from stroke 96.5%. The results were similar in the on-pump group. The Cleveland clinic compared propensity matched 812 patients and found at 4 years follow-up freedom from MI of 92.6%, freedom from PCI of 94.3%, and freedom from coronary reoperation of 98.1% in the off-
Midterm Results Of Off-Pump Coronary Artery Bypass Surgery In Indian Patients

pump group which was not significantly different from on-pump group.

Our own results of freedom from angina of 93%, freedom from hospitalization of 95%, freedom from re-intervention of 98.5% and negative Treadmill in 90% of patients at 3-year follow-up compares quite well with the western literature. An important point to note is that only 58% of patients are on regular drugs in the follow-up and still the results are quite encouraging. The non-compliance of patients of such large numbers would have caused a large amount of recurrent cardiac events if these patients had been offered percutaneous interventions in the first occasion. Apart from cost and vessel morphology in Indian context, this noncompliant patient population is another overriding factor in favor of coronary artery surgery compared to percutaneous interventions. The results would have been disastrous with drug eluting stents if such large number of patients did not take their antiplatelet medications properly. This argument may not be valid in the west where the compliance rate is much higher. More than 80% patients were found to be compliant in one of the trials, assessing the outcome with use of secondary prevention medications after coronary artery bypass graft surgery. 100% cessation of smoking in this study might have contributed to the better results despite poor compliance with medications. From the socio economic point of view, the patients are able to comply with the “stopsmoking” advice better than “take drugs regularly” advice because it does not cost anything to follow the first advice. It is noteworthy that nearly 85% followed a regular exercise program in this group. Probably cessation of smoking (100%) and regular exercise (85%) was responsible for the good lipid control (81%) in this group even if they were found to be poor in drug compliance.

LIMITATIONS

This represents the work of a single surgeon. This may not truly reflect the results of a multicenter trial. The data were collected retrospectively. The numbers are too small for any meaningful statistical evaluation. There is no angiographic study to prove patency of the grafts. It is not possible because of economic factors. It is very difficult to convince our patients to undergo these tests. However this study reflects the true-world situation in the developing countries. A follow-up of 100% is exceptional by our standards. This was achievable because most of the patients live within a radius of 150 kilometers from this hospital.

CONCLUSIONS

Our results confirm that off-pump multivesel revascularisation is associated with good midterm results and quality of life as on-pump coronary surgery. The question arises as to why this strategy when results are the same. Some trials have shown better results with OPCAB in high risk situations. The most decisive factor for its widespread adoption in developing countries is the cost saving. It is heartening to note from our results that economic considerations have not compromised on the midterm results of the patients.

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