CABG Continues To Be Treatment of Choice In Multivessel CAD
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A B S T R A C T

Coronary artery bypass grafting (CABG) and percutaneous coronary interventions (PCI) are alternative methods of revascularization in patients with coronary artery disease. Results of trials, comparing PCI and CABG indicate that rate of death or myocardial infarctions are similar with either treatment strategy. Management with PCI is, however associated with an increased requirement for subsequent, additional revascularization. In recent years there have been phenomenal technological advances both in cardiology and cardiac surgery. Cardiac surgery has seen development of off-pump coronary artery bypass (OPCAB) surgery, minimally invasive cardiac surgery, endoscopic and robotic surgery, similar changes have occurred in cardiology practice. It has evolved from simple angioplasty in single vessel disease to angioplasty combined with stenting to drug-coated stents and complex multivessel angioplasties.

Despite development of drug-eluting stents and newer platelet inhibitors there are still many contraindications to percutaneous interventions such as left main coronary artery disease, proximal diffusely diseased arteries with multiple lesions. Diabetes mellitus remains special challenge for both cardiologists and cardiac surgeons. All the randomized trials have depicted superior results of surgical revascularization in diabetic patients.

Use of newer antiplatelet agents such as clopidogrel and glycoprotein IIb / IIIa inhibitors would affect result of both PCI and CABG, only long-term prospective, randomized multicenter trials would show their long-term effects.

At present in a patient with multivessel disease with extensive coronary artery diseases, severe left ventricular dysfunction, left main coronary artery disease, diabetes, CABG / OCPAB is preferred approach for myocardial revascularization.

INTRODUCTION

New techniques and technologies are being introduced in Cardiac Surgery and Cardiology at a phenomenal speed. Almost everyone is in the race for a ‘first’ new technique to etch their name in the historical records. In recent years while cardiac surgery has shifted from cardiopulmonary bypass (CPB) to off-pump coronary artery bypass (OPCAB) surgery; from sternotomy and complete exposure of the heart to minimally invasive small incisions, endoscopic and robotic surgery; the cardiology practice has seen the similar changes from simple angioplasty in single vessel disease to angioplasty combined with stenting to drug-coated stents and complex multi-vessel angioplasties.

The speed with which surgeons and cardiologists are adapting these techniques and technologies is alarming. Change is not only welcome, it is considered progressive. Yet the adoption of new techniques and technologies is to be taken with caution, because patient safety is of utmost importance for both cardiac surgeons and cardiologists.

For patients who have coronary anatomy suitable for either multivessel stenting or CABG, the question thus arises as to which is the better approach.

There is no difference in long-term mortality in patients randomized to either coronary artery bypass grafting (CABG) or percutaneous intervention (PCI), in large, randomized trials of multivessel balloon angioplasty versus CABG.1-3 There is, however an increased need for subsequent percutaneous or surgical target vessel revascularization (TVR) in patients who initially undergo balloon angioplasty as compared with CABG.

In patients with diabetes mellitus, there is mortality benefit favouring CABG in patients with multivessel coronary artery disease.

Compared with balloon angioplasty, stenting reduces the need for TVR, but there has never been evidence from randomized trials that stents decrease mortality, compared with balloon angioplasty.4 Infact, existing data suggest that stents may increase mortality, in both acute myocardial infarction (MI)4 and chronic stable angina.5 There is ‘cheese grater’ effect due to embolization of the plaque by stents,6 leading to increased periprocedural MI.7 Data are particularly strong for patients with multivessel disease, left ventricular dysfunction and left main coronary stenosis in favour of CABG.8 However, CABG carries a greater risk of more subtle deficits in neurocognitve function,9 but off-pump coronary artery bypass (OPCAB) has
CABG continues to be treatment of choice in multivessel CAD.

significantly reduced the cognitive dysfunction noted with on-pump CABG.\textsuperscript{14,15}

**CABG VERSUS STENTING FOR MULTIVESSEL CORONARY ARTERY DISEASE**

**The Evidence**

The arterial revascularization therapy study (ARTS) and stent or surgery (SOS) trials have tried to evaluate whether CABG or PCI would be better approach for multivessel disease.\textsuperscript{16,17} The ARTS found that TVR rates were still higher in patients with stents as compared with CABG; however TVR rates were lower with stenting than they had been in previous trials of balloon angioplasty. The diabetic cohort did have a higher mortality in stenting arm than in the CABG arm of the trial.\textsuperscript{16}

At one year the SoS study found a lower mortality in those undergoing CABG as compared with PCI (CABG 2% versus PCI 5%; hazard ratio 2.91%, 95% CI 1.29-6.53, P=0.01).\textsuperscript{17} The increased mortality seen in the PCI patients cannot be attributed to diabetes, as the prevalence of diabetes was quite low in SoS trial. Some intervention cardiologists have explained the results of SoS trial as ‘surprisingly low surgical mortality’ in the patients randomized to CABG, but with contemporary surgical techniques this mortality is not unreasonable. It is scientifically unjustified to dismiss outright the mortality difference observed in this randomized trial. Twenty one percent of patient in PCI group required additional revascularization procedures compared with 6% in CABG group (hazard ratio 3.85, 95% CI 2.5-5.79, P < 0.0001).\textsuperscript{17}

### Table 1: Demographic Profile: OPCAB vs CCAB

<table>
<thead>
<tr>
<th>Variables</th>
<th>OPCAB Group (n = 11,747)</th>
<th>CCAB Group (n = 10,736)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10,234 (87.1%)</td>
<td>9626 (89.7%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female</td>
<td>1513 (12.9%)</td>
<td>1110 (10.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3947 (33.6%)</td>
<td>3199 (29.8%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>5712 (48.6%)</td>
<td>5110 (47.6%)</td>
<td>0.126</td>
</tr>
<tr>
<td>Acute MI</td>
<td>223 (1.9%)</td>
<td>258 (2.4%)</td>
<td>0.010</td>
</tr>
<tr>
<td>History of CVA</td>
<td>188 (1.6%)</td>
<td>151 (1.4%)</td>
<td>0.256</td>
</tr>
<tr>
<td>Preoperative IABP</td>
<td>564 (4.8%)</td>
<td>462 (4.0%)</td>
<td>0.079</td>
</tr>
<tr>
<td>Aortic atheroma</td>
<td>2208 (18.8%)</td>
<td>322 (3.0%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>COPD</td>
<td>963 (8.2%)</td>
<td>891 (8.3%)</td>
<td>0.801</td>
</tr>
</tbody>
</table>

**CABG in The Current Perspective: Escorts Heart Institute and Research Centre (EHIRC) Experience**

In last five years, there has been development of new techniques on beating or arrested hearts, elimination of extra-corporeal circulation and designing “off-pump” operations, thus eliminating oxygenators, heart-lung bypass circuits and related procedures. For coronary revascularization Minimally Invasive Direct Coronary Artery Bypass (MIDCAB) and OPCAB are available. These procedures have further reduced the risks associated with conventional coronary artery bypass grafting (C-CAB). To improve myocardial blood supply in patients with ungraftable vessels, the techniques of Trans-Mycardial Laser revascularization (TMLR) and angiogenesis have provided new options. The application of robotic-assisted surgery and port access surgery have further widened the horizon of minimally invasive surgery.

The diffuse systemic inflammatory response (SIRS) to CPB has the potential of engendering a constellation of clinical, biochemical and radiological manifestations of multi-organ dysfunction. Attenuation of the complex multifaceted response can have tremendous prognostic implications; this has been achieved by elimination of CPB for coronary artery bypass operations and doing most of CABG as an OPCAB procedure. Since deliberate induction of global ischemia is unnecessary in OPCAB, it is logical to suppose that iatrogenic biochemical injury
to myocardium would not occur. Akines et al first suggested that OPCAB preserved cardiac functions. In different prospective randomized studies, Ascione, Yam Dijk, Bennets and Masuda and their collaborators reported minimal changes in biochemical markers of myocardial injury.

OPCAB has been demonstrated to offer prognostic advantage in high risk patients requiring myocardial revascularization. Elderly patients with renal and neurological dysfunction, acute myocardial infarction, impaired ventricular functions have better outcome with OPCAB surgery.

The techniques of OPCAB are constantly undergoing refinement and many areas of potential benefit are vigorously explored. Increased number of surgeons are expanding their OPCAB practice and offering many more patients this technique of myocardial revascularization. During the past 5 years the number of OPCAB surgeries performed at EHIRC has increased from 4.95% in initial period to 96% recently with excellent and comparable results with other series (Fig. 1, Table 1-6).

Recently total endoscopic coronary bypass (TECAB) has been performed using Zeus da Vince Systems™ from Intuitive Surgicals. This consists of three robotic arms that are attached to a platform, a complex master – console system is used for replicating the arm and hand movements of the surgeon (Fig. 2). These robotic arms hold specially designed endoscopic instruments, which are placed through small ports (Fig. 3).

All these newer developments have reduced the morbidity associated with CABG tremendously and can provide better short-term and long-term outcome than PCI.

### Discussion

**CABG VsPCI: The Indian Challenge**

All the major trials comparing CABG and PCI have shown that there may not be a major difference in long-term mortality of patients with these procedures, but patients undergoing PCI required subsequent and many times repeated target vessel revascularization. This becomes important in Indian setting, since in this era of drug-coated stents one single drug-coated stent implantation may cost between 2.0 to 2.5 lac rupees. A multivessel drug eluting stenting procedure requiring three stents may cost whopping 5-7 lac rupees, whereas a multivessel CABG in the best of centers still costs between 1.5 to 2.0 lac rupees, and the cost is going down with the advent of OPCAB.
surgery. Moreover, the risk involved with CABG is reducing with OPCAB procedures.27 The cost involved in multivessel stenting and the potential risks involved puts a big question mark on the face of multivessel PCI especially in an Indian perspective.

Incidence of diabetes mellitus is increasing progressively in Indian population and majority of coronary intervention patients are diabetic. All the major trials comparing CABG and PCI have shown there is mortality benefit favouring CABG in diabetic patients with multivessel coronary artery disease, and these patients are particularly more prone for subsequent reinterventions, perioperative myocardial infarctions and death. In Western population, cumulative medical care cost during the first year after coronary angioplasty are 40-60% higher than the initial revascularization procedure itself because of procedural failure or restenosis requiring subsequent bypass surgery or repeat angioplasty.28-30 This can be no different in Indian perspective although there are no such studies. The cost and the potential complications make multivessel PCI not a very suitable procedure for Indian population.

Contraindications to PCI and CABG
Despite development of drug-eluting stents and newer platelet inhibitors there are still many contraindications to percutaneous interventions (Table 7).

With more and more high risk cases done as OPCAB and with newer technologies there are virtually no contraindications to surgical myocardial revascularization procedures. In fact, surgical myocardial revascularization has potential advantages over PCI (Table 8).

Role of Newer Anti-Platelet Agents
In contemporary PCI, the role of concomitant glycoprotein (GP) IIb/IIIa inhibitor is firmly established. The evaluation of IIb/IIIa platelet inhibitor for stenting (EPISTENT) study demonstrated reduced mortality in patients receiving stents who were randomized to abciximab instead of placebo.31 Although all three commercially available GP IIb/IIIa (abciximab, Tirofiban and Reopro) reduce periprocedural MI but they have potentially high incidence of GI and other visceral organ bleeding.

Prolonged dual antiplatelet therapy with aspirin plus clopidogrel could further decrease TVR and recurrent ischemic events in
both PCI and CAGB/OPCAB\textsuperscript{32}. Statin therapy, appropriate control of diabetes would improve outcome in both PCI and CAGB patients.

**CONCLUSION**

All the different lines of treatment of coronary artery disease PCI, CAGB and medical therapy are improving. At present, in a patient with multivessel disease with extensive coronary artery disease, severe left ventricular dysfunction, left main coronary disease, diabetes, CAGB/OPCAB is the preferred mode of revascularization. PCI may be performed when there more focal stenosis, although concomitant GP IIb/IIIa inhibition, inspire of its risks is essential. However, large randomized prospective, multicentre trials employing newer modalities of treatment in both the fields are required to settle the issue in favour of one or another.

**REFERENCES**


