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Authors' Reply

Is off-pump CABG really a better substitute for on-pump CABG in all cases of coronary artery disease?

Dear Editor,

We appreciate the comments of Hilal Olgun Kucuk, Ugur Kucuk et al on our investigation. Actually we had done that study to show the outcome of CABG in patients who were dependent on hemodialysis in comparison with the other patients that are not dependent to hemodialysis. But in response to the opinion of these Authors that mentioned OPCAB is a way to prevent most of the complications of On-pump CABG we decided to review all previous studies that had compared the On-pump CABG with Off-pump CABG.

Really nowadays there are a lot of arguments in cardiac surgery about doing coronary artery bypass grafting using Heart Lung Machine and cardioplegic solution during bypass (standard on-pump CABG) or doing CABG without cardiopulmonary bypass and without cardioplegia solution injection through the ascending aorta (OPCAB).

At the beginning of OPCAB usage there were some studies that all showed the superiority of OPCAB in comparison with on-pump CABG, specially focusing on lesser bleeding, less morbidity and shorter hospital stay, but most of them were descriptive non-randomized clinical reports and there were not real rigorously controlled clinical studies[1].

After that time many randomized trials have been done, but till now it is not certainly approved that CABG using Off-pump technique has clear advantages or it's outcomes is similar to or identical to the outcomes of on-pump CABG (the gold standard of CABG).

Review and Discussion

At first it is better to review the retrospective studies that compared the two techniques:

1. Racz et al[2] reviewed the outcomes of more than 68000 CABG which have been done during 1997-2000 in New York State. Among them more than 9000 cases were done OPCAB. In this study, no significant difference was found in the appearance of death, perioperative MI, wound infection, renal failure requiring dialysis, or respiratory failure. There were, however, significantly higher rates of stroke (2.0% versus 1.6%, p = 0.003) and bleeding requiring reoperation (2.2% versus 1.6%, $p < 0.001$) in the standard CABG group. A significantly higher risk of gastrointestinal complications (1.2% versus 0.9%, $p = 0.003$) was observed in the OPCAB group. Hospital length of stay was longer in the standard CABG group by 1 day. At 3-year follow-up, patients in the standard CABG group had a higher survival rate (89.6% versus 88.8%, $p = 0.022$) and need for repeat revascularization (percutaneous coronary intervention or CABG, 84.7% versus 82.1%, $p < 0.0001$). In data from the last 2 years of the study (i.e., excluding the first year), the survival benefit disappeared but the freedom from death and revascularization remained. The authors concluded that patients undergoing standard CABG with CPB have better rates of long-term survival and freedom from repeat revascularization.
2. Sabik et al[3] in Cleveland Clinic reviewed a retrospective series of 812 propensity-matched patients (out of a total of 3712 patients undergoing isolated CABG during a 4-year period), with 406 patients in both the standard CABG and OPCAB groups. These authors concluded that mid-term outcomes with OPCAB and standard on-pump CABG were equivalent.

There are also two meta-analyses that have been done in many centers. First was done by Reston et al[4], they reviewed 46 621 patients in 53 studies (10 were randomized control trials, 5 were prospective controlled trials, and 38 were retrospective controlled studies). Regarding to mid-term outcome, the recurrence of angina was no different (odds ratio [OR] = 1.28, $p = 0.309$, confidence

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interval [CI] = 0.79 to 2.05), but the risk of repeat intervention by percutaneous or open strategy (OR = 3.63, p = 0.0001, CI = 1.91 to 6.78) or death was lower in the standard CABG group (OR = 0.49, p = 0.008, CI = 0.29 to 0.82).

Prospective, randomized, blinded studies are the best studies to rely on. Gerola et al[5] have done a multicenteric prospective study in Brazil in 160 selected low risk patients with one or two vessel coronary artery disease. The exclusion criteria included left ventricular dysfunction (ejection fraction < 35%), renal failure, left circumflex territory lesions, urgent or emergent procedures, hemodynamic instability, concomitant significant carotid disease, age > 70 years, and other comorbidities such as hepatitis, AIDS, and morbid obesity. No significant difference was seen in time to extubation, pulmonary complications (anything causing hypoxia), MI, postoperative blood loss, need for blood transfusions, wound infections, neurological dysfunction, or atrial fibrillation. Length of stay in the intensive care unit (ICU) was similar. Postoperative length of stay was not significantly different (8.0 ± 3.1 days in the standard CABG group versus 7.6 ± 3.4 days in the OPCAB group [p = 0.75]). Mortality rate was not significantly different between groups (3.7% versus 1.2%, p = 0.62). The authors concluded that in these groups of patients neither procedure was superior to the other.

Straka et al[6] had done a single institutional trial in the Czech Republic, 400 consecutive, unselected patients randomized to standard CABG or OPCAB. There were no significant differences between groups in postoperative mortality, MI, stroke, atrial fibrillation, wound infections, or renal failure requiring dialysis. The number of distal anastomoses for patients was higher in the standard CABG group (2.7 versus 2.3, p < 0.001). The total blood loss was higher in the standard CABG group (680 versus 560 mL, p < 0.001), but the number of transfused patients and reoperations for bleeding was not significantly different. The time to extubation, length of ICU stay, and total hospital length of stay were not significantly different between groups. The authors concluded that the OPCAB strategy can be applied widely to unselected patients and is as safe and effective as conventional standard CABG.

Khan et al[7] have done another recent trial at the Royal Brompton Hospital in London, involving 103 patients who required at least 3 grafts and were randomized to standard CABG or OPCAB. Of the 103 patients, 82 were reevaluated and underwent angiography at 3 months. There were no deaths, strokes, or MIs, and Canadian Cardiovascular Society/NYHA classes were similar at 3 months. The striking finding in this study was that graft patency was 98% in the standard CABG group and 88% in the OPCAB group (p = 0.002). Graft patency of the left anterior descending graft was 100% in the standard CABG group and 92% in the OPCAB group (p = 0.07). Circumflex graft patency was 95% in the CPB group and 87% in the OPCAB group (p = 0.25). Right coronary artery graft patency was 100% in the standard CABG group and 84% in the OPCAB group (p = 0.01). The left internal thoracic artery graft patency was 100% in the standard CABG group and 92% in the OPCAB group (p = 0.05). The patency of the radial arteries operated on in this study was 100% in the standard CABG group and 76% in the OPCAB group (p = 0.01). Saphenous vein graft patency was 95% in the standard CABG group and 91% in the OPCAB group (p = 0.42). The authors concluded that OPCAB may not be widely applicable but may have a role in selected patients with good targets or serious comorbidities.

Nathoe et al[8] performed a multicenter study involving 281 patients, 142 of whom underwent OPCAB. Patients in this study had predominantly 1- or 2-vessel coronary artery disease. Nathoe et al concluded that there was no significant difference in cardiac outcome between on-pump CABG and OPCAB.

The GOPCABE study[9] included 2539 patients randomized to off-pump or on-pump surgery. Patients were high risk, with a mean age of 78.5 years and a EuroScore of 8 in both groups. During the course of the trial, 9% of patients crossed over from off-pump to on-pump, and 5% crossed over from on-pump to off-pump. The primary end point – a composite of death, MI, stroke, repeat revascularization, and new renal-replacement therapy – was similar in the two groups, as were most of the individual components.

GOPCABE: 30-Day Results.

End point	Off-pump (%)	On-pump (%)	HR (95% CI)	p
Primary composite	7.8	8.2	0.95 (0.71-1.28)	0.74
Death	2.6	2.9	0.92 (0.57-1.51)	0.75
MI	1.5	1.7	0.92 (0.51-1.66)	0.79
Stroke	2.2	2.7	0.83 (0.50-1.38)	0.47
Repeat revascularization	1.3	0.4	2.42 (1.03-5.72)	0.04
New renal replacement therapy	2.4	3.1	0.80 (0.49-1.29)	0.36

The 12-month results of the CORONARY trial10 (in 4752 patients), showed no difference in the primary end point, a composite of death, stroke, MI, and renal failure. Therefore, Lamy et al concluded that, in experienced hands, both procedures are reasonable options.

CORONARY Trial: One-Year Results.

End point	Off-pump (%)	On-pump (%)	HR (95% CI)
Primary composite	12.2	13.3	0.91 (0.77-1.07)
Death	5.2	5.0	1.03 (0.80-1.32)
Nonfatal MI	6.8	7.5	0.90 (0.73-1.12)
Stroke	1.5	1.7	0.90 (0.57-1.41)
New renal failure	1.3	1.3	0.97 (0.59-1.60)

Conclusions

Actually the outcome of both procedures may be excellent and it depends on many factors other than the technique of surgery (standard on-pump CABG or Off-pump CABG) alone. In most databases the mortality rate is between < 1% to > 6% and the outcome after CABG is more dependent to the skill of the surgeon, quality of the institution, and systems approach.

The greatest utility for OPCAB is probably the severely calcified or diseased aorta in which manipulation or clamping of the aorta can be associated with severe neurological consequences[1].

Conflict of Interest

The Authors declare that they have no conflict of interests.

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