

Myocardial Revascularization Without Extracorporeal Circulation (OPCAB)

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Introdction

- Extracorporeal circulation has led to a great development in cardiovascular surgery.
- ONCAB is the gold standard method of surgical revascularization.
- CPB is related to complications :
 - I. myocardial ischemic injury
 - II. Coagulation disorder
 - III. Systemic inflammatory response
 - IV. Strokes
 - V. ...
- These complications was the reasons to OPCAB.

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- Despite the initial enthusiasm on OPCAB, it's accounts only 20% of myocardial revascularization procedures worldwide.
- OPCAB is considered a more technically challenging and demanding approach.
- Additional factors including :
 - I. graft patency
 - II. Completeness of revascularization
 - III. Repeat revascularization requirement

OPCAB Indications

- The International Society for Minimally Invasive Cardiothoracic Surgery recommendations states that perioperative morbidity, neurocognitive dysfunction, and hospitalization are decreased through OPCAB, so high-risk patients having severe ascending aortic calcification, liver disease, renal insufficiency, or other systemic processes should be candidates for OPCAB to reduce morbidity and mortality.
- According to the American Heart Association Guidelines in 2011, both ONCAB and OPCAB are reasonable, depending on patient's characteristics. Hence, a patient having a heavily calcified ascending aorta can gain profit from OPCAB

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- On the other hand, the European Guidelines (2010) do not state anything for OPCAB indications. The elderly and the patients with the left main stem coronary artery disease, impaired left ventricular function, a porcelain aorta, right coronary artery disease, non-STEMI, or pulmonary edema are more often candidates for OPCAB.

Quality-quantity of Distal Anastomoses

- During OPCAB, patients are more prone to significant local damage of the vascular endothelium contributing to local thrombosis.
- Inferior and posterolateral coronary vessels are more difficult to be grafted through OPCAB. Such anastomoses require significant heart moving leading to hemodynamic instability, so they may be frequently performed more distally on the coronary branches during OPCAB than during ONCAB.
- Therefore, OPCAB is related to a lower mean of distal anastomoses, when compared to on-pump CABG.

Early Postoperative Complications

- In-hospital Mortality

None of the two methods seems to be superior with regard to 30-day mortality according to the international literature. No difference in 30-day mortality was reported. Randomized trial to date comparing OPCAB with ONCAB. retrospectively comparing 59,000 patients who received ONCAB with 9000 patients who received OPCAB, found no difference in 30-day mortality, as well as in risk-adjusted in-hospital mortality.

- Blood loss

Many randomized studies have shown that blood loss after OPCAB is significantly less than after on-pump CABG. That is the reason why OPCAB requires a significantly smaller number of red packed-cell and clotting-product transfusions

Myocardial injury

- Microemboli and the inevitable ischemic time after clamping the aorta are the main harmful effects of extracorporeal circulation on the coronary circulation.
- Smaller increase in cardiac enzymes (creatine kinase-MB [CK-MB] and troponin) in the group of OPCAB compared to the group of on-pump CABG.
- Another study of MRI evaluation of viable myocardium after revascularization, comparing these two approaches, has failed to prove any significant difference between them although hemodynamic markers, such as cardiac biomarkers and end-systolic volume, were better preserved early postoperatively after OPCAB

Atrial fibrillation

- Many of studies report OPCAB was related to a lower incidence of postoperative atrial fibrillation.
- However, the propensity score analyses did not confirm a statistically significant difference in atrial fibrillation occurrence between the two methods.

Neurological and neurocognitive damage

- A significantly lower number of microemboli, mainly due to avoiding emboli-producing extracorporeal circulation and maneuvers on the thoracic aorta, has been reported since the beginning of OPCAB application compared to on-pump CABG.
- This is especially true in the elderly, where their frequency after on-pump CABG is at least 4-fold that after OPCAB.

Renal impairment

- Contrary to what someone would expect, avoiding extracorporeal circulation does not prevent the kidney from a possible damage. Indeed, randomized comparative studies between the two methods did not demonstrate any superiority of OPCAB against on-pump CABG concerning renal complications.
- Same results were reported who observed less renal failure requiring dialysis related to OPCAB.

Left ventricle ejection fraction

- The slight postoperative improvement of the ejection fraction of the left ventricle observed does not significantly differ depending on the method used, even at 12 months postoperatively.
- The ejection fraction was improved from 54% to 61% in the OPCAB group, whereas it was improved from 53% to 59% in the on-pump CABG group.

Intensive Care Unit and Hospital Stay Duration

- There are controversial results regarding Intensive Care Unit (ICU) and total hospital stay after OPCAB or on-pump CABG.
- There are few studies that show a statistically significant superiority of OPCAB in terms of ICU stay or in terms of total hospital stay.
- This was due to increased respiratory complications, increased need for respiratory support, increased intubation time, and increased need for inotropes.
- On the other hand, a compare the hospital stay duration between patients submitted to OPCAB and those submitted to on-pump CABG, reported longer hospital stay (by 0.6 days) when OPCAB was performed.

Mid and Long-term Outcomes

- Most complaints raised against OPCAB concern the quality of peripheral anastomoses which will undoubtedly influence long-term graft patency. and if complete revascularization is assured during OPCAB.
- The event-free rate at 3 years was 88% after on-pump CABG against 84% after OPCAB.
- A significant superiority of OPCAB in graft patency at 3 months postoperatively (88% vs. 98%; $P = 0.002$).
- Statistically significant greater long-term graft patency after on-pump CABG.

Mid and Long-term Outcomes

- Study showed that there is a statistically significant higher vein graft occlusion rate after OPCAB than after on-pump CABG.
- Patients submitted to OPCAB are significantly more prone to recurrence of angina and subsequent need for revascularization 3 years after their first revascularization operation.
- On the other hand, a randomized study did not show any statistically significant difference regarding graft restenosis, clinical recurrence of angina, myocardial infarction, and need for reperfusion between OPCAB and on-pump CABG.

Conversion Rate

- The need for conversion of OPCAB to conventional CABG is possible varying from 1% to 2%.
- Limited surgical experience and 3-vessel disease make the conversion rate higher. Myocardial ischemia, anatomical unsuitability of the target vessel, and hemodynamic instability.
- Several studies have observed that emergent conversion from OPCAB to ONCAB is related to increased morbidity and mortality

Quality of Life

- According to study, although the quality of life is significantly improved at 12 months postoperatively, there is no significant difference between OPCAB and on-pump CABG.
- However, OPCAB was superior to on-pump CABG in terms of postoperative social functioning. No significant difference between the two methods regarding quality of life was either observed.

Conclusions

- Revascularization procedure without the use of extracorporeal circulation is a challenge for the surgeon.
- OPCAB offers to the patient reperfusion simultaneously preventing him from the deleterious effects of extracorporeal circulation.
- Completeness of revascularization, technical precision, and anastomotic quality should not be compromised to avoid CPB.
- The surgeon should choose which technique he will perform depending on the case.
- low-risk patients do not appear to take benefit from OPCAB application compared to the conventional on-pump CABG.

Conclusions

- Subgroups such as the elderly, patients with left main stem coronary artery disease, patients with functional impairment of the left ventricle, those having a calcified aorta (porcelain aorta), those suffering from the right coronary artery disease or NSTEMI infarction, as well as patients experiencing pulmonary hypertension or pulmonary edema seem to gain profit from the OPCAB procedure.
- High-risk subgroups such as women and diabetics may also be candidates for OPCAB.



THANK YOU