

# Challenges in High Risk Patients Planned for off Pump Coronary Artery Bypass Surgery: A Review

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## Abstract

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High risk patients scheduled for off pump coronary artery bypass (OPCAB) surgery imparts tremendous challenges to anesthetists. There is very little literature for the management of high risk patients subjected for off pump coronary artery bypass surgery. High risk patients have increased morbidity and mortality. The review describes the different causes of high risk patients, the problems faced during OPCAB and the management strategy. Risk stratification, optimization of organ functions prior to surgery, stable induction, maintenance and postoperative multidisciplinary team work will provide better outcome. Pre-induction precautionary arrangements of inotropes, defibrillator, intra aortic balloon pump, temporary pacemaker, back up of cardiopulmonary bypass and cell saver are useful for combating the cardiac emergencies. Along with routine monitors, pulmonary artery catheter, Transesophageal echocardiography, pulse contour (Flo Trac), non-invasive cardiac output monitors, bispectral index and near infrared spectroscopy play a major role to diagnose the critical events and hence help in prompt management.

**Keywords:** Off Pump Coronary Artery Bypass; Anaesthesia; Surgery; High Risk Patient.

## Introduction

It is challenging task for anesthetists for managing patients undergoing off pump coronary artery bypass (OPCAB) [1]. The hemodynamic changes during enucleation of heart for graft anastomosis produce hypotension, bradycardia or tachycardia, dysrhythmia and occasionally cardiovascular collapse [1]. Anesthetist try his best how to avoid the problems and optimize hemodynamic parameters and discharge the patient after OPCAB with normal and faster recovery. The subset of patients with Euro SCORE > 6, Ejection Fraction (EF) < 35%, renal failure, post stroke, chronic obstructive lung disease (COPD), severely diseased coronary arteries and post mechanical ventilation are high risk patients for OPCAB. Studies have shown that OPCAB has better outcome than on pump coronary artery bypass (ONCAB) [2], but anesthetist face real bigger challenge to manage these patients. The review discusses the different issues related to anesthesia in high risk patients undergoing OPCAB.

## Methodology

Literature search for the review was performed in Pub Med and Google Scholar with the key words of off pump coronary artery bypass, anaesthesia, surgery and high risk patient for last 10 years. Thirty (30) studies were related to OPCAB but not for high risk patients. Three (3) studies were matching to high risk patients undergoing OPCAB surgery. All the studies, published information and clinical experiences were compiled to write the review.

### *High risk patients attending for OPCAB*

The different categories of patients with high risks are classified in (Table 1).

### *Anesthesia challenges*

The successful management of these patients requires an experienced team work. The anesthetist and surgeon have to communicate about the risks, problems during surgery and the strategy to be

adopted. Proper planning is the key to success. Patients have to be evaluated clinically and as per the findings of all recent investigations. The non-cardiac problems should be corrected and optimized.

**Table 1:**

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A) Cardiac Causes-
Low Ejection Fraction of <35%,
Big heart,
Mitral regurgitation,
Preoperative heart failure within 2 weeks,
Supported with preoperative IABP,
Urgent procedural status
B) Coronary causes-
Intra-myocardial coronary arteries,
Increasing number of diseased arteries,
Posteriorly located vessels,
Redo-CABG
C) Renal- Chronic renal failure
D) EuroSCORE $\geq 6$ , age- advanced age (octogenarians)
E) Neurological-Post stroke
F) Respiratory - Prior prolonged ventilation

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#### A) Preoperative preparation

- a) *Risk stratification:* The cardiac and non-cardiac risk factors to be assessed as per Euro SCORE, Parsonnet Score and Society of Thoracic Surgeons or any of the risk scoring system [3,4]. The risks are to be explained to patient and his family members.
- b) *Optimization:* The pulmonary, renal and other metabolic and endocrine function to be optimized prior to surgery. The cardiac drugs to be modified, adjusted and drugs like clopidogrel are to be stopped 5 days before surgery. The window period of 7 days between angiography and surgery may be followed.
- c) *Premedication:* These patients are to be premedicated according to the level of anxiety, cardiac reserve, age and coexisting risks. Alprazolam 0.25-0.5mg at bed time and day of surgery is sufficient to relieve the anxiety. Low dose morphine or fentanyl may be administered before shifting to operation room (OR).

#### B) Intraoperative

The following preparations must be confirmed before induction of anesthesia in the operating room (OR).

- a. Emergency drugs: Adrenaline, Noradrenaline, dopamine, nitroglycerine, lignocaine and esmolol are to be prepared and kept ready for use if required for management of unwanted hemodynamic alteration.

- b. External defibrillator patches fixed on the back of patient
- c. Temporary pacing electrodes and pacemaker
- d. IABP machine
- e. Heart-lung machine with perfusionist standby
- f. Cell saver
- g. Warm operation room (OR) and warming methods
- h. Blood and fluid

*Induction:* Preoxygenation with 100% O<sub>2</sub> for 3-5 minutes. Etomidate, fentanyl, midazolam and rocuronium combination is preferred to deliver a stable hemodynamic and tracheal intubation [5].

*Maintenance:* O<sub>2</sub>-air, sevoflurane/ isoflurane / desflurane, fentanyl, atracurium and midazolam with maintaining Bispectral Index (BIS) value of 45-60. Heparin 200IU/kg is administered before take down of left internal mammary artery or graft anastomosis with a target activated clotting time of >350 seconds.

*Hemodynamic management:* During OPCAB surgery some critical hemodynamic alterations creates tremendous risks leading to adverse outcome and morbidities. The critical events during surgery are mentioned in the Table 2. The critical events are faster in onset, more frequent and more severe in high risk patients.

**Table 2:** Critical events during OPCAB.

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- |  |
|--|
| 1. Hypotension, hypertension, bradycardia, heart block                                 |
| 2. New onset myocardial Infarction   |
| 3. Arrhythmia (atrial fibrillation, ventricular fibrillation, ventricular tachycardia) |
| 4. Cerebral injury   |
| 5. Worsening of mitral regurgitation, tricuspid regurgitation                          |
| 6. Bleeding  |
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The enucleation, compression by stabilizers like Octopus and Star fish (Figure 1), twisting and suturing on a beating heart potentiate all the critical events.

The critical events are faster in onset, more frequent and more severe in high risk patients. IABP prior to OPCAB may be useful to provide stability in situations of critical hemodynamic events and sudden cardiovascular collapse [6].

If severe hemodynamic collapse and persistent new MI occurred; the strategies to be adopted is mentioned in the flow diagram Figure 2.

#### Management of Bleeding

It is essential to manage the antiplatelet and antithrombotic drugs before surgery. The platelet

count, prothrombin time and international normalized time (INR) are to be in normal range before surgery. Normovolemic hemo-dilution, intra-coronary shunts during grafting and routine use of cell-saving devices help in blood conservation and avoid complication related to bleeding and blood transfusion [7].

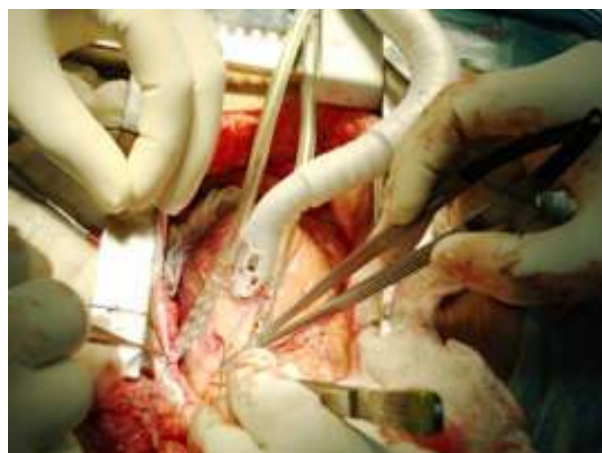


Fig. 1: Showing OPCAB surgery with Octopus stabilizer.

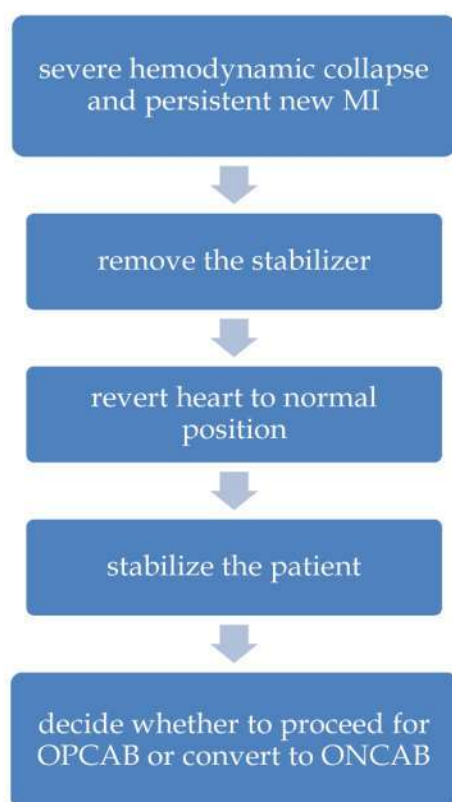


Fig. 2: Flow diagram for management of hemodynamic collapse during OPCAB surgery. Abbreviations- OPCAB- off pump coronary artery bypass; ONCAB- on pump coronary artery bypass; MI- myocardial ischemia

### During surgical procedure for OPCAB

- I. *Hemodynamic goal:* Maintaining an mean arterial pressure (MAP) >70 mmHg allows an adequate coronary perfusion, sinus rhythm, heart rate between 60-90/min, preload and afterload to be maintained, contractility to be maintained, mixed venous O<sub>2</sub> saturation (SvO<sub>2</sub>) > 50%,cautious fluid loading and haematocrit >30. Trendelenburg position, right side tilting of patient and the use of vasopressor and/or inotropes (phenylephrine, dopamine, or norepinephrine) are useful in managing hypotension. NTG is used for anti MI and hypertension. HR control achieved by esmolol / diltiazam/dexmedetomidine. Prophylactic IABP before initiation of OPCAB may be used in patients with ongoing ischemia, compromised coronary blood flow and unstable hemodynamic.
- II. *Sequence of grafting:* The first anastomosis should be LIMA (Left Internal Mammary Artery) to LAD (Left Anterior Descending Artery), Second anastomosis - Venous graft proximal end anastomosis in aorta followed by distal end (Aorta to Circumflex artery), Third - (Aorta to Right coronary artery) (Figure 3).



Fig. 3: The distal end of saphenous venous grafts are ready for anastomosis to circumflex and right coronary artery. The proximal end of veins is already attached to ascending aorta. The left internal mammary artery was anastomosed first to left anterior descending artery

- III. *Anaesthesia (Anaesthetics for fast track):* Less cardiac depressants and auto or quickly metabolised with less dependent on renal and hepatic degradation. Inhalation agents like sevoflurane and desflurane are useful.
- IV. Potassium, magnesium and calcium homeostasis to be maintained.

### C) Monitoring

The following (Table 3) monitors are very much useful to show the different parameters about the

vital functions. The information will guide the anesthesiologist and intensivist to manage the patients with high risks.

**Table 3:**

1. Electrocardiogram (ECG)-5 lead ECG
2. Invasive Blood Pressure (IBP)
3. Central Venous Catheter for central venous pressure (CVP)
4. Pulmonary artery Catheter(PAC) for cardiac output (CO)
5. Flo Trac / Vigileo monitor for SV, SVV, CO, CI, TFC, O <sub>2</sub> content
6. Non invasive Cardiac Output (NICO) monitor.
7. Temperature
8. Transesophageal Echocardiography (TEE)
9. Near Infrared Spectroscopy (NIRS)
10. Bispectral Index (BIS)
11. Activated clotting Time (ACT) and other Coagulation monitor

The uses of Transesophageal Echocardiography monitoring during OPCAB are detect

- New RWMA
- Contractility
- Worsening of MR, TR
- Atheroma Aorta

The uses of Pulmonary artery catheter monitoring are to measure

- PA pressure
- CO/ CI
- LVEDP(by PAOP)
- New MI ('v' wave)
- SVO<sub>2</sub>
- SVR
- Pacing (if port for pacing present)

#### D) Post-surgery management

- a. *Cardiac stability:* the cardiovascular functions to be stabilized by inotropes, vasopressors, inodilator, vasodilator, pacing and IABP. The high risk patients require high dose of inotropes like noradrenalin and adrenaline. The blood loss is to be controlled promptly and if required surgical re-exploration; blood, platelet and fresh frozen plasma may be transfused.
- b. *Stabilization of all organ function:* The respiratory, metabolic, renal and all other co-morbidity has to be looked and optimization must be assured in the post surgery period. This will help for faster and safe recovery and discharge of the patient.

- c. *Analgesia:* The commonly used analgesia are opioids like fentanyl, NSAID, paracetamol and occasionally regional (epidural analgesia). The type and dose of analgesia should be titrated to the renal function, age and risk factors.
- d. *Multidisciplinary team approach:* The high risk patients may require the interventions from non-cardiac physicians. These patients should be managed by the other department with their expertise.
- e. *Ischemia management:* The high risk patients after OPCAB surgery may have some mild degree of new onset ischemia manifestations. Adequate oxygenation, hemoglobin and blood pressure have to be ensured for better myocardial oxygen delivery. Inotropes and coronary dilators like nitroglycerine are useful. IABP support helps to augment the diastolic blood flow to coronary artery and also reduces the after-load on heart, hence relieves the ischemia. Anticoagulants like aspirin, nitrates, and statins are essential for graft patency.

#### Summary

High risk patients scheduled for OPCAB surgery imparts tremendous challenges to anesthetists. Risk stratification, optimization of organ functions prior to surgery, stable induction, maintenance and post-operative multidisciplinary team work will provide better outcome. Pre-induction precautionary arrangements of inotropes, defibrillator, IABP, temporary pacemaker, CPB and cell saver are useful for combating the cardiac emergencies. Along with routine monitors, pulmonary artery catheter, TEE, Flotrac/Vigileo, non-invasive cardiac output monitors, BIS and NIRS plays a major role to diagnose the critical events and hence help in prompt management.

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*Conflict of Interest:* Nil

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