Off-Pump Cardiac Surgery is not Dead

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…” a surgeon who tries to suture a heart wound deserves to loose the esteem of his colleagues”...
Introduction

- Surgical revascularization of the coronary arterial system remains the foundation of cardiothoracic surgical practice

- While many procedures in other specialties have undergone change and redefinition due to introduction of facilitating technology

- Standard coronary bypass grafting has resisted change to a large degree
The success of catheter-based techniques for treating ischemic coronary syndromes, combined with the shift towards less invasive approaches, has renewed interest in minimally invasive techniques, including beating heart surgery.
Recognition of improved outcomes in selected patients with the elimination of CPB serves as the impetus to develop off-pump coronary artery bypass (OPCAB) as a treatment option for multivessel coronary artery disease.
Patient Selection

- Few absolute contraindications
- Surgeon’s experience and comfort level
- Initial or limited experience:
  - hemodynamically stable
  - limited number of bypasses (1-3)
  - located in easily accessible areas
- Large target
Avoid

- Emergency
- Hemodynamically or electrically unstable
- Small, heavily calcified targets
Anesthesia

- Close collaboration with familiar and involved anesthesia team
- Avoid high-dose narcotics, use short and intermediate-acting anesthetic agents
- Maintain body heat
- Early extubation
- Preload sensitive: volume loading/Trendelenburg
- Pacing wires, intracardiac shunts
- Heparin: 1.5 – 2.0 mg/kg
- Cardiopulmonary bypass circuit available
Surgical technique

- Incision
- Patient positioning
- Target exposure and stabilization
- Grafting strategy
- Proximal anastomosis
Surgical technique
OPCAB Offers Significant Clinical Benefits

- Off-pump coronary artery bypass surgery may be superior to conventional CABG in many patients, especially those who are considered “high-risk”1

  - Reduced transfusions and bleeding 2,4
  - Reduced inotropes2,4
  - Reduced arrhythmias2-4
  - Reduced sternal wound infection2-4
  - Reduced cerebral emboli and cognitive dysfunction3
  - Reduced postoperative hospital length of stay2

OPCAB surgery has been associated with reduced stroke, atrial fibrillation, and procedure-related infection.

- OPCAB was associated with 50% relative risk reduction of stroke.\textsuperscript{1,2}
- Postoperative atrial fibrillation events were reduced by 80 per 1000 CABGs performed off-pump.\textsuperscript{1,2}
- OPCAB surgery was associated with a 48% reduction in the risk of wound infection as compared with on-pump surgery.\textsuperscript{1,2}

Who Is a High-Risk Patient?

- Today’s Surgical Candidates:
  - Experience abnormal ventricular function
  - Have extensive coronary disease
  - Present with multiple comorbidities
  - Are elderly (>65 years)

Percentage Relative Increase in Risk Factors (1990-1999)^1

- NY Heart Assoc. Class IV: 75%
- Left Main Stenosis >50%: 75%
- COPD: 71%
- Diabetes: 53%
- Renal Failure: 52%
- Hypertension: 36%
- Triple Vessel Disease: 23%
- Female Gender: 12%

What Risks Do High-Risk Patients Face?

- High-risk patients of all types have higher incidence of postoperative complications after traditional CABG procedures:
  - Atrial fibrillation
  - Need for transfusion
  - Respiratory infections
  - Inpatient inotropes
  - Cognitive dysfunction (2 to 6 months)
  - Mortality (30 days)

OPCAB Offers Better Outcomes for High-Risk Patients

- This procedure offers hope for better outcomes in high-risk patients whose prognosis may have been poor with conventional bypass surgery.¹

Women: A Specific High-Risk Group

- Coronary artery disease is the leading cause of mortality in women: ≈ 234,000 deaths annually in the US

- Women have higher morbidity and mortality rates than men after conventional CABG

- Female gender is an independent risk factor for mortality in conventional CABG


Women: Potential Factors in High-Risk

- Female patients are recognized as being at increasingly high risk:
  - Later clinical presentation
  - More acute presentation
  - Older age at presentation
  - Higher incidence of diabetes mellitus
Female patients are recognized as being at increasingly high risk:

- Higher incidence of left ventricular hypertrophy and hypertensive heart disease
- Smaller coronary arteries
- Less benefit of LITA graft
- Less complete revascularization
OPCAB Offers Better Outcomes for Women

- In a large study of 7,376 women, OPCAB procedures resulted not only in a lower mortality rate, but also in significant reductions in neurological, respiratory, and bleeding complications compared with on-pump procedures.1
OPCAB Offers Better Outcomes for Women

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Logistic regression analysis of 3,688 off-pump and 3,688 on-pump women.
Renal Dysfunction: A High-Risk Subgroup

- Among patients about to undergo CABG surgery, as many as 78% have at least some form of renal dysfunction preoperatively1.

In a study of patients with renal dysfunction, acute renal failure was >2.5-fold more common among patients receiving conventional CABG compared with OPCAB patients.

Renal Dysfunction: A High-Risk Subgroup

- Off-pump coronary bypass surgery was shown to:
  
  - Reduce postoperative morbidity and risk of acute renal failure2.
  
  - Significantly lower serum creatinine and urea at 12 hours post-op (P<.5) 2


Renal Dysfunction: Postoperative Benefits

- In patients with preoperative renal dysfunction, OPCAB surgery resulted in significantly lower incidence of postoperative inotropic requirement, arrhythmias, stroke, and acute renal failure\(^1\).

Clampless Beating Heart Surgery: The Key To Better Outcomes

- Emboli have been linked to adverse clinical outcomes, both immediate and delayed.
- Elimination of CPB and cross-clamp has led to decreased emboli and improved clinical outcomes.
- Side-biting clamp has been shown to liberate a large percentage of emboli.
- Reducing aortic manipulation has the potential to further improve patient outcomes.

Atherosclerotic Embolization Linked to Adverse Outcomes

Additional OPCAB Benefits: Reductions In The Cost Of Care

Studies have documented the significant reductions in cost of care made possible with off-pump coronary artery bypass (OPCAB), compared with traditional CABG:
Additional OPCAB Benefits: Reductions In The Cost Of Care

- In one study, OPCAB reduced postoperative hospital stay from 5.5 days in the CABG group to 3.3 days ($P = .02$), with a decrease in hospital cost of 24%.


- In another study, mean total hospitalization cost per patient at discharge was $2,272 less for OPCAB patients ($P = .002$).

Additional OPCAB Benefits: Reductions In The Cost Of Care

- Stroke alone is a major cause of increased cost of care; a third study reported that patients with adverse neurologic outcomes³
  - Stayed an additional 4 to 8 days in the ICU
  - Stayed an additional 7 days in the ward
  - Required long-term out-of-hospital medical and rehabilitation services

Graft Patency

**FACT:** Graft patency is similar to conventional CABG.

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Demonstrated Clinical Benefit to Avoiding CPB

- In a large retrospective analysis (STS Adult Cardiac Surgery Database), OPCAB decreased risk-adjusted mortality and major complications.

Demonstrated Clinical Benefit to Avoiding CPB

- Three randomized studies documented the following benefits:
  - OPCAB reduced chest infection by 12%, inotrope requirement by 18%, RBC transfusion by 31% and intubation time by 16%.

Demonstrated Clinical Benefit to Avoiding CPB

- Three randomized studies documented the following benefits:
  - OPCAB patients had a 41% reduction in CK-MB release, 75% reduction in transfusions and 1-day reduction in length of stay.

Demonstrated Clinical Benefit to Avoiding CPB

- Three randomized studies documented the following benefits:
  - OPCAB resulted in shorter length of stay, less myocardial injury, and reduced transfusion requirements with similar completeness of revascularization and in-hospital and 30-day outcomes.

Although 80% of surgeons perform OPCAB, <30% of the cases are performed with the OPCAB approach.

Source: STS Floor Surveys (2003-2006)
Conclusion

- Learning curve
- Technically demanding
- The impetus to change established patterns of practice rests upon the scientific validation of the clinical benefits of off-pump surgery
Conclusion

- Large multicenter studies are needed to produce confirmation of the clinical benefits seen in smaller studies.

- Performance of these studies can be problematic given the inherent prejudice either for or against the technique by participating surgeons.

- OPCB is not for everybody.

- Off-pump cardiac surgery is not dead.