

Off Pump Complete Revascularization Through Left Lateral Thoracotomy (ThoraCAB): NICVD Experience

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Abstract:

Key words:

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Background: Conventional coronary artery bypass surgery (CABG) is associated with substantial morbidity caused by cardiopulmonary bypass (CPB) and median sternotomy. Here we described an innovative technique to perform complete revascularization through a left lateral thoracotomy without CPB (ThoraCAB).

Methods: From September 2005 to December 2008 a total 83 patients underwent ThoraCAB in National Institute of Cardio Vascular Diseases (NICVD). The patient is positioned with the left side elevated to 45 degree. A 6 to 8 inches long incision is made over the left 4th or 5th intercostal space from just medial to the nipple to the anterior axillary line. The left internal mammary artery (LIMA) is harvested as a pedicle graft under vision. Distal coronary anastomosis is completed first on the beating heart using a stabilizer, followed by proximal anastomoses on the descending aorta. Perioperative and postoperative complication the arrhythmia hypotension wound infection death was observed.

Results: Complete revascularization was achieved in all patients. The number of grafts averaged 2.18 ± 1.08 per patients. One patient died (1.2%) due to severe respiratory acidosis. One patient (1.2%) was converted to CPB due to arrhythmia. No strokes were observed. Of these patients, 7.2% developed new onset postoperative atrial fibrillation.

Conclusion: ThoraCAB has been feasible in the vast majority of the patients requiring CABG surgery. The prevalence of the post operative atrial fibrillation was low. Left lateral thoracotomy offers an attractive and effective alteration to Off Pump median sternotomy.

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Introduction:

Coronary artery bypass surgery has been performed for more than 30 years using cardiopulmonary bypass (CPB) and full median sternotomy. CPB and median sternotomy has been considered to be causes of major morbidities in cardiac surgery. Use of CPB has been associated with total body inflammatory response, microemboli, neurologic complications, excessive use of blood and blood products.¹

Median sternotomy can be complicated by sternal dehiscence, mediastinitis, prolonged pain, tinnitus on activities, prolonged recovery and delay in return to normal life style.

The first offpump CABG was performed in 1958.¹ Recently Calafiore and associates, Westaby and Benetti and others have reported relatively a large series with excellent results. Most of these

operations were performed using a full median sternotomy. Thoracotomy has been selectively used.³ Numerous study have reported the advantages of lesser invasive approaches, which includes decreased use of blood,¹⁻³ decreased pain, decreased length of hospitalization,⁴ faster recovery and over all decrease in cost,^{1,2,4} decreased stroke; decreased mortality.²⁻⁴

Coronary artery bypass grafting without CPB using left lateral thoracotomy approach is of renewed interest.⁵ We evaluated 83 patients who underwent minimally invasive direct coronary artery bypass grafting a left lateral thoracotomy (Thora CAB).

Patients and methods:

From 2005 to 2008, 83 patients underwent complete revascularization. These patients represent 15% of total CABG surgery during this time of period. Myocardial bridging, which was

detectable at angiography was considered as an absolute contraindication for this procedure.¹ Patients with pleural thickening, subclavian artery aneurysm or stenosis were also excluded from this procedure. All patients had high thoracic epidural anesthesia (TEA) as an adjunct to general anesthesia. There were 78 male and 5 female patients, with an age range of 54.3 ± 12.4 years. The ejection fraction of these patients ranged from 30% to 60% with a mean of $41.2 \pm 20.6\%$.

The procedure was performed using 6-8 inches long incision made over left 4th or 5th intercostal space by positioning the patient with the left side elevated to 45 degree. The left internal mammary artery (LIMA) was harvested as a pedicle graft under vision. Distal coronary anastomoses were completed first on the beating heart using a stabilizer, followed by proximal anastomoses on the descending aorta.

Table-I
Clinical characteristics of patients

Characteristics	Number (%)
Angina	83 (100%)
MI	35 (42%)
Peripheral vascular disease	18 (19%)
Dyslipidaemia	47 (55%)
Diabetes	37 (47.3%)
Hypertension	31 (38.5%)
Smoking	48 (58%)

Table-II
Preoperative demographics.

Variables	Results
Age (years)	54.3 ± 12.4
Sex (M: F)	5.25 : 1
Disease	
One vessel	19 (21%)
Two vessels	38 (46%)
Three vessels	26 (32%)
Left main stenosis	21 (24%)
Ejection fraction (%)	$41.2 \pm 20.6\%$

All these patients received a central venous pressure (CVP) catheter to monitor CVP. Saphenous vein conduit was harvested from the right lower extremity. In male patient the incision was made 1 inch below and 1 inch medial to the

left nipple and extended laterally to mid axillary line. In female patient, the incision was made more laterally avoiding the sub mammary crease. The latissimus dorsi muscle was usually spared.

The skeletonized left internal mammary artery (LIMA) was dissected under direct vision. Systemic heparin, 1-2 mg/kg was given. Activated clotting time measurement were performed at every 20 to 30 minutes intervals and maintained more than 300 seconds. The LIMA was transected between clips and allowed to auto dilate. A generous pericardiotomy was created obliquely from the apex of the left ventricle to the ascending aorta. Several pericardial sutures were placed. The right pericardial sutures were placed as follows: 1st suture, 2-3 inches from apex of the heart along the anterior edge of the pericardium, 2nd suture, mid right atrial level, 2-3 inches posterior and lateral (deep) to the cut edge of the pericardium, 3rd suture, at the level of the superior vena cava, 4th suture, at the superior aspect of pericardiotomy, 1 inch posterior and deep to the cut edge of the pericardium. The left sided pericardial sutures were placed as follows: 1st suture, in the left lower border of the pericardium, 2nd suture, in the mid portion of the pericardium, 3rd suture, at the junction of the pericardium and pulmonary artery.

The LIMA was anastomized to the left anterior descending artery. The order of distal anastomosis was dictated by the coronary anatomy and myocardial function. After positioning the mechanical stabilizer (Medtronic octopus stabilizer), a 4-0 polypropylene suture was placed deep around the proximal coronary artery and looped twice to provide proximal occlusion. No distal tourniquets were applied, an intracoronary shunt (flow through) was reserved for patients with evidence of ischemia during tourniquet occlusion and most right coronary artery anastomoses are impaired visualization because of excessive back bleeding. Deep pericardial sutures and sling were used to position the heart for optimal visualization of the distal right coronary arteries and laterals. To maintain hemodynamic stability, patients were placed in deep Trendelenburg position for grafting the obtuse marginal branch and the right coronary artery and its branches. A minority of patients required low dose epinephrine which was titrated to maintain satisfactory hemodynamics. Then

proximal anastomosis was completed. A partial occluding clamp was applied on the descending aorta. During this time systolic blood pressure was maintained between 70 to 90 mmHg by titrating intravenous nitroglycerin. An aortotomy was performed using 4mm aortic punch. Proximal anastomoses were completed using 6-0 polypropylene running suture. The anastomosis and the entire length of the conduits were thoroughly inspected for hemostasis.

The average number of grafts per patient was 2.18 (range 1 to 3). Arteries grafted include left anterior descending coronary (LAD) artery, diagonals, ramus, obtuse marginal (OM) branches, posterior descending artery (PDA) and posterolateral branches.

After completion of the anastomosis, graft flow was measured using an ultrasonic flow meter. Protamine was administered to achieve full heparin reversal. After placing a temporary pacing wire in the right ventricular epicardium, the pericardium and mediastinal part was loosely approximated to cover the grafts and to prevent cardiac herniation. Two 32 Fr chest tube was inserted in the pleural cavity. Profound analgesia was given. The outcome of operative procedure is summarized in table II.

Results:

Planned complete revascularization was achieved in all patients. Only 37 diabetic patients were treated for superficial chest wound infection. One patient presented with pleural effusion requiring drainage. All patients were extubated in ICU immediately after surgery. Most patients did not complain of significant incisional pain after the first 24 hours of surgery. No stroke was observed of these patients. 12 patients discharged in 6 days or less. Mortality of this early report is 1 (1.2%) and it was for severe respiratory acidosis. Conversion to CPB is 1 (1.2%) due to arrhythmia. No important post operative complication except soft tissue wound infection 4 (4.81%) were noted. Phrenic nerve injury observed in no patients. 8 patients (7.2%) developed new onset atrial fibrillation.

Discussion:

The left lateral thoracotomy without CPB (ThoraCAB) appears to offer all of the putative benefits of off-pump CABG while avoiding the

morbidity caused by median sternotomy.¹ Thoracotomy approach provides the opportunity to avoid several hazards: a redo sternotomy, dissection of hostile mediastinum and manipulation of the heart.^{2,6}

We have done all proximal anastomoses on descending aorta are patients with LIMA (Y graft). Sudhir and associates used proximal anastomosis in descending thoracic aorta in 16 patients undergoing redo CABG.⁷ Left thoracotomy for reoperation revascularization in selected cases represents a useful alternative in the armamentarium of Cardiac surgeons.²

A rare complication non anastomotic avulsion of LIMA were occurred in cases in MIDCAB, resulted in significant hemodynamic impairment after ischemic compromise.⁸

4 cases of redo CABG, circumflex coronary artery was successfully revascularized via a small left thoracotomy. Thoracotomy approach provides the opportunity to avoid several hazards: a redo sternotomy, dissection of hostile mediastinum and manipulation of the heart.^{2,6}

In 256 patients LIMA to LAD bypass was performed in off pump via the left thoracotomy (n=129) and sternotomy (n=127). No hospital death in MIDCAB.^{9,10}

A study showed that postoperative AF in the first 6 weeks after surgery was 4% (4 to 96) for MIDCAB and 28% (12 to 42) for S-CABG.^{4,2} Other study showed only 8%⁷ in comparison of 20% - 40% in all conventional CABG.⁴ In our series 8 patients (7.2%) had postoperative AF.

The LIMA patency was 98.2%. Some patients need port access CABG than MIDCAB in case of congestive cardiac failure, malignant ventricular arrhythmia due to their LIMA patencies.

The application of high thoracic anesthesia (TEA) as an adjunct to general anesthesia is increasingly being used for CABG with extracorporeal circulation, hemodynamics were stable throughout the operation.³

D. Christnan and coworkers² found wound infection in 6 patients (4.7%) among 129 patients. We have found infection in 4 (two) patients (4.81%).

Moshkovitz and associates, in 1994, were among the first to report the use of left thoracotomy for

coronary revascularization. In 2000 D'Ancona and coworkers related their experience through a left posterior thoracotomy in 67 patients and these patients had a 95.5% early freedom from major complication.¹¹

Single vessel anastomosis (LIMA to LAD) may be performed through small (8 to 10 cm) left lateral thoracotomy without CPB.⁹

Conclusion:

Our surgical patients are now generally older, have more co morbid conditions and more severe left ventricular dysfunction and many have had previous catheter-based interventions. These patients are at increased surgical risk and may have poor surgical targets. To handle this group of patients, surgeons need to incorporate newer procedures into their practice.

The off pump left lateral thoracotomy approach appears to be feasible in the majority of patients requiring CABG. It potentially offers an attractive and effective alternative to off pump median sternotomy. The procedure can be accomplished safely with acceptable mortality and morbidity. Fast recovery and pain management may early return to normal activities be added benefits.

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