

# CORONARY REVACULARIZATION IN POOR LEFT VENTRICE

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## ABSTRACT

**Introduction :** Coronary artery bypass grafting for patients with ischemic left ventricular dysfunction (ILVD) remains superior to medical therapy. Although patients with severe ventricular dysfunction have improved long-term survival after coronary bypass procedures, operative morbidity and mortality rates remain high.

**Objective:** The present study was conducted to evaluate our experience with coronary artery bypass grafting in patients with severe left ventricular dysfunction.

**METHODS:** This is a retrospective study in which we evaluated 84 patients operated at our Institute for Ischaemic Heart Disease from November 2006 to May 2007. Patients were considered as having severe left ventricular dysfunction if their ejection fractions were found to be between 20% - 30% on Echocardiography.

We included all adults patients with isolated coronary artery disease having an ejection fraction of < 20% - 30%, below 80 years of age, either sex, with left main stem stenosis. Patients undergoing combined procedures as CABG with valvular surgery, left ventricular aneurysm resection, surgery for arrhythmias, octogenarians, LV clots, patients with cardiomyopathy and patients having a base line ejection fraction of < 20% on echocardiography were excluded from the study. Angiograms showed triple vessel disease in 77 (80 %) patients, severe LM disease in 18 (19 %) patients. Preoperative myocardial viability studies were assessed by stress thallium scintigraphy viability test of the myocardium in 14 (16.6 %) patients. Stress dobutamine echocardiography was assessed in 6 (7.4 %) patients. Total number of grafts was 298. Mean number of grafts per patient was 3.4 (2-5). Left internal mammary artery (LIMA) graft was used in 79 (94 %) procedures. The average time on bypass was 83 minutes (standard deviation  $\pm 41$  minutes) with a mean cross-clamp time of 46 minutes (standard deviation  $\pm 28$  minutes).

**RESULTS:** The hospital mortality rate was 32.1%. The main cause of death was cardiac or multi-organ failure. Low cardiac output syndrome and supraventricular; ventricular dysrrhythmias were the most common postoperative complications Left ventricular ejection fraction (assessed postoperatively in 57 of the hospital survivors) improved from 14.6% to 24.2% postoperatively (19.4 % increase) ( $p < 0.001$ ). Diabetes mellitus, female gender, COPD, reopening and pre operative functional class status were the main predictors of operative and post operative patient convalescence and out comes. Left main and urgent surgeries secondary to unstable hemodynamics and unstable angina preoperatively were independent factors of high morbidity and mortality.

**CONCLUSION:** Coronary artery bypass grafting can be performed relatively safely with good medium-term survival. The internal mammary artery can be safely used as a conduit. The use of coronary artery bypass grafting is encouraged for this group of patients and may provide a viable alternative to transplantation in selected patients.

## INTRODUCTION

The choice of optimal treatment strategy in patients with coronary artery disease (CAD) and severe left ventricular (LV) dysfunction is often difficult.<sup>[1]</sup>

The life expectancy for patients with severely depressed left ventricular (LV) function (ejection fraction [EF]  $\leq 0.20$ ) is very short. Data from the Framingham Heart Study demonstrate that the median survival after development of congestive heart failure is 1.7 years in men and 3.2 years in women [7]. Cardiac surgeons have generally been hesitant to operate on this group of patients due to an excessive postbypass mortality of 13% to 33% and a

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morbidity of 40% to 67%.<sup>[8]</sup> Often these patients are referred directly for cardiac transplantation, before definitive evaluation for revascularization. Compared with medical therapy alone, coronary artery bypass surgery improves survival in patients with coronary disease and left ventricular dysfunction. Many of these patients have a hibernating myocardium secondary to chronic ischemia with the potential for improvement in left ventricular function and heart failure symptoms following revascularization therapy. Cardiac transplantation remains the treatment of choice for patients with severe congestive heart failure.<sup>[1-6]</sup>

The results of a merely pharmacological therapy in patients with advanced left ventricular dysfunction are unsatisfactory. Coronary artery bypass grafting is frequently the only therapeutic option, but ventricular dysfunction is generally considered to be a risk factor.<sup>[2]</sup> In most prospective, randomized studies, severely depressed left ventricular function is found to be the independent predictor of increased morbidity and mortality after myocardial revascularization.<sup>[3]</sup>

CABG procedure in the presence of HM (hibernating myocardium) enhances LV recovery of function and has a favorable prognosis. Functional benefit of the left ventricle, however, appears to be time-limited, despite remarkable improvement in patient functional capacity. Advanced preoperative heart failure, minimal perioperative improvement of LVEF, and age account for a poor long-term prognosis.<sup>[4]</sup>

Myocardial revascularization in patients with left ventricular failure (ejection fraction < 30%) offers survival comparable to heart transplantation.<sup>[5]</sup>

In spite of improving early and late survival after revascularization for ischemic left ventricular failure, patients presenting with congestive failure have an unsatisfactory symptom-free survival. In patients with CAD, severe LV dysfunction, and the evidence of viability in dysfunctional myocardium, coronary revascularization improves survival.<sup>[5]</sup>

## **METHODS:**

### **Study design**

This was a retrospective observational study.

## **PATIENT POPULATION**

We included 84 patients from Nov 2006 to May 2007 who were operated on for CABG as the sole procedure

## **INCLUSION CRITERIA**

All elective and urgent cases were included in the sample who had ischaemic heart disease with severe left ventricular dysfunction having an ejection fraction of 20 % - 30 % on echocardiography.

## **EXCLUSION CRITERIA**

All the patients with concomitant valvular pathology, cardiomyopathies, LV clots, octogenarians, aneurysmal ventricles and patients with a base line EF of < 20 % were excluded from this study.

## **RISK FACTORS AND DEMOGRAPHICS.**

Pre operative variables included age, gender, Canadian Cardiovascular Society Angina Classification (CCS), diabetes mellitus, COPD, hypertension, smoking and coronary vessel disease distribution.

All elective cases were included and emergent and urgent cases were not included in the sample.

## **PRE OPERATIVE ASSESSMENT OF EF**

Pre operatively the subjective assessment of wall motion or ejection fraction was based on echocardiography and cardiac catheterization. Per operative visual assessment was also taken as a valid parameter.

## **OPERATIVE DETAILS**

All CABGs were done using cardiopulmonary bypass. Intermittent cross clamp with fibrillation and single cross clamp with antegrade tepid blood cardioplegia were used for myocardial protection. All patients were cooled down to 28 ° Celsius. The average time on bypass was 83 minutes (standard deviation  $\pm 41$  minutes) with a mean cross-clamp time of 46 minutes (standard deviation  $\pm 28$  minutes). OR [With an average myocardial ischemia time of 53  $\pm$  23 minutes and bypasses time of 104  $\pm$  31 minutes].

Prolonged bypass time was associated with post-operative irritability and restlessness, signs of cerebral oedema. These patients revealed remarkable improvements with intra-



venous steroids and osmotic diuretics.

We used left internal mammary artery (LIMA) in 79 (94%) patients as a graft for left anterior descending artery (LAD). In the remaining venous grafts were used as conduits. Use of LIMA was deferred in subjects with unstable hemodynamic state and by the time patient was on pump the SVG was readily harvested and ready to use. The LIMA was electively abandoned in the 2 patients with COPD, while it was damaged during harvesting in two patients..

Total distal anastomoses were 298 with 3.4 grafts per patient. Incomplete revascularization in patients was secondary to heavily diseased target vessels or inadequate size.

Pre operatively the requirement for intra aortic balloon pump counterpulsation was met in 7 (8.33 %) patients secondary to unstable angina and sign and symptoms of heart failure.

The indications for intra-aortic balloon pump counterpulsation in 54 (64.2 %), [total of 62 patients (73.8%)] patients included low cardiac output, unstable angina, and failure to wean off cardiopulmonary bypass. Mean time for IABP was 48 hours (20 – 76hrs).

## POST OPERATIVE

The mean duration in the intensive care unit was 4.1 days (standard deviation  $\pm$  7.1 days). Inotropic support was required by patients (16%) for 6 to 24 hours, (36%) for 1 to 3 days, but no patient required inotropes more than 5 days. patients (5 %) required no inotropic support after operation.

CVA was observed in 3 patients. One patient with left main operated in emergency, developed stroke secondary to low pressure state pre operatively. In the other two patients the reason remained obscure. 7 patients out of 84 had a positive carotid bruit on auscultation. There was a lumen obstruction ranging from 30% to 60% unilateral in two and bilateral disease in the rest on carotid Doppler study. History of vertigo was positive in all patients with a positive carotid bruit associated with or without postural changes. None of the patients with carotid artery disease developed TIA or stroke post operatively. Reoperations carried out in this cohort were 14 (16.66 %). Main in-

dications were excessive bleeding and cardiac tamponade.

## FINDINGS

Bleeding from branches of IMA in 5 patients, from sternal wires in 2, heal of distal end in 1 and generalized bleeding with no definitive surgical bleeder in 2 patients were found per operatively.

Mediastinitis developed in 5 out of 14 patients (35 %) leading to sternal dehiscence, in 3 patients. Multiple admissions, dressings, resuturing, prolonged ICU stay, all gave extra financial and social burden to the patients. Ventricular dysrhythmias namely VF was encountered in ( ) AF ( ), VT ( ).

## RESULTS:

The hospital mortality rate was 32.1% (27 out of 84) with per-operative mortality of 4 (4.7 %)(table deaths), 7 (8.33 %), with in a few hours after shifting into the ICU in a low output state and heavy inotropic support and 16 (19.04 %) patients in 3-17 days (mean 10 days). The main cause of death was cardiac or multi-organ failure. Low cardiac output syndrome and supraventricular; ventricular dysrhythmias were the most common postoperative complications. The improvement was more pronounced in patients in whom preoperative end-diastolic diameter of the left ventricle was below 70 mm, and in patients with hibernating segments on dobutamine stress echo. Advanced age and low cardiac output syndrome were found to be risk factors of early mortality. Canadian Cardiovascular Society angina class improved postoperatively by 1.9 categories and New York Heart Association congestive heart failure class improved from class IV to III and III to II categories. Left ventricular ejection fraction (assessed postoperatively in 57 of the hospital survivors) improved from 14.6% to 24.2% postoperatively (19.4 % increase) ( $p < 0.001$ ). Diabetes mellitus, female gender, COPD, reopening and pre operative functional class status were the main predictors of operative and post operative patient convalescence and outcomes. Left main and urgent surgeries secondary to unstable hemodynamics and unstable angina preoperatively were independent factors of high morbidity and mortality.

Low output syndrome remained the main predictor of mortality and morbidity post-operatively as compared to those in whom it did



not develop. Associated supraventricular and ventricular dysrhythmias were added moribund factors requiring multiple cardioversions and continuous anti arrhythmic intravenous agents, prolonging ICU stay and ventilation time.

## DISCUSSION

The life expectancy for patients with severely depressed left ventricular (LV) function (ejection fraction [EF] 0.20) is very short. Data from the Framingham Heart Study demonstrate that the median survival after development of congestive heart failure is 1.7 years in men and 3.2 years in women.<sup>[11]</sup> Cardiac surgeons have generally been hesitant to operate on this group of patients due to an excessive post-bypass mortality of 13% to 33% and a morbidity of 40% to 67%.<sup>[2]</sup> Often these patients are referred directly for cardiac transplantation, before definitive evaluation for revascularization.<sup>[3]</sup> Several large centers have shown comparable short-term morbidity, mortality, and functional recovery with coronary artery bypass grafting (CABG) rather than transplantation in this challenging group of patients [4-6]. In addition, revascularization has been shown to be much less expensive with similar survival when compared to transplantation.<sup>[7]</sup>

Recent research has demonstrated that a substantial percentage of these patients may have "hibernating" or "stunned" myocardium that does not contribute to the overall contractility of the heart, but may be recruited into functionality with revascularization [8-9]. Thus patients with severe LV dysfunction may have a significant amount of rejuvenated myocardium and a prolonged survival benefit, enhanced LV function, and improved New York Heart Association (NYHA) functional class after coronary bypass.<sup>[10]</sup>

A number of studies have concluded that CABG in patients with left ventricular dysfunction provide better prognosis than conservative treatment.<sup>(1,3-5)</sup> Alderman et al.<sup>4</sup> reported a 5 years survival rate of 43 % for the medical group compared to 63 % for the surgical group. The criteria determining impaired ventricular function are different. The predictive value of viability assessment with quantitative positron emission tomography for symptomatic and functional outcome for coronary artery surgery as treatment for ischemic heart failure has been shown by Pagano.<sup>[2]</sup>

Results' supporting the use of CABG in patients with severe left ventricular dysfunction, without case selection on the basis of viability studies or visibility of distal vessels, has been reported by Mickleborough.<sup>6</sup> Nevertheless the degree of improvement in left ventricular function after revascularization is dictated by the amount of viable myocardium.<sup>[2-8]</sup>

The limitations of the study are the fact that preoperative stress-thallium scintigraphy data were obtained in only 14 (16.6 %) patients. Stress dobutamine echocardiography was assessed in only 6 (7.4 %) patients. We used left ventricular ejection fraction assessed by echocardiography, ventriculography and CI in some patients to gain left ventricular function preoperatively. No control angiograms and ventriculography were performed in our patients during follow up as long as there was indication for it (sign of myocardial ischemia). Echocardiography was used to assess ejection fraction postoperatively. A distinct LVEF improvement was showed comparing those two variables (preoperative and postoperative) assessed by ECHO.

Left ventricular end-systolic volume index is the most important predictor of survival after coronary artery bypass surgery in patients with severe myocardial dysfunction.<sup>[18]</sup>

The operative mortality rate in patients undergoing CABG is associated with several risk factors as female gender, advanced age, obesity, severity of coronary artery disease, low Cardiac index, preoperative cardiac failure etc.<sup>[5-7-11]</sup>

The risk of operative death for patients with ejection fractions between 20% and 40% was predicted by urgency of operation, reoperation, sex, myocardial protection, and age. The only predictor of risk of operative death for patients with ejection fractions less than 20% was urgency of operation. Patients undergoing isolated coronary artery bypass grafting who have severe ventricular dysfunction are therefore a highly selected, high-risk subgroup of patients who risk depends on the urgency.

Patients with a significant amount of hibernating myocardium or reversible ventricular dysfunction have been shown to have immediate improvement in LV function as soon as 6 to 48 hours after revascularization.<sup>[11-17]</sup>



Stepwise logistic regression analyses identified nine independent predictors of low output syndrome: (1) left ventricular ejection fraction less than 20% (2) repeat operation (3) emergency operation (4) female gender (5) diabetes (6) age older than 70 years (7) left main coronary artery stenosis (8) recent myocardial infarction and (9) triple-vessel disease.

Diabetes was not a predictor of mortality after CABG surgery among patients with LV dysfunction despite associated comorbidities. However, diabetes was associated with increased postoperative complications and re-hospitalization.

Patients with poor left ventricular function are at a higher risk when subjected to bypass operation; the use of IMA did not show any disadvantages in comparison to exclusively vein graft surgery, except of a higher perioperative bleeding risk. Due to better long term results IMA should be used routinely also in bypass-patients with poor left ventricular function.<sup>[21]</sup>

Low cardiac output syndrome is a clinical outcome that may result from inadequate myocardial protection or perioperative ischemic injury. Patients at high risk for the development of low cardiac output syndrome should

be the focus of trials of new techniques of myocardial protection to resuscitate the ischaemic myocardium. Patients with LVEF < 40% are at higher operative risk because of often postoperative low output syndrome. Low output syndrome can be successfully treated with IABP. CABG significantly improves circulatory sufficiency in patients with LVEF < 40%.<sup>[18 - 19]</sup>

In patients with left ventricular dysfunction, myocardial revascularization can be performed relatively safely with good medium term survival and improvement in quality of life and in left ventricular function. Coronary artery bypass graft may be offered to patients with impaired ventricular function, but careful patient selection and management when considering these patients for operation should assess potentially reversible dysfunction.<sup>[20]</sup>

## CONCLUSION :

Coronary artery bypass grafting can be performed relatively safely with good medium-term survival. The internal mammary artery can be safely used as a conduit. The use of coronary artery bypass grafting is encouraged for this group of patients and may provide a viable alternative to transplantation in selected patients.

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