Long-Term Results of Coronary Artery Bypass Grafting in Patients With Left Ventricular Dysfunction

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Background. **In this prospective study, we investigated the determinants of long-term outcome, symptoms, and left ventricular function after coronary artery bypass grafting in patients with a moderate to severely decreased left ventricular ejection fraction.**

Methods. **Between 1997 and 1998, 75 consecutive patients with moderate to severe left ventricular dysfunction underwent coronary artery bypass grafting procedures. The operative mortality rate was 4.0%, and the 72 survivors were monitored for 8 years. The end points were mortality, symptomatic status (New York Heart Association [NYHA] functional class), and left ventricular function.**

Results. **The total survival rate after 8 years was 89.3%. During follow-up, 8 patients died. Death was attributed to a cardiac cause in 5 patients and to a noncardiac cause in 3. There was no statistically significant difference between preoperative and late postoperative NYHA functional class, despite a statistically significant improvement that persisted for up to 4 years after CABG. The results of echocardiography showed a statistically significant improvement in the left ventricular ejection fraction (from 0.322 ± 0.06 preoperatively to 0.463 ± 0.02 at follow-up, $p < 0.001$). Multivariate analysis revealed that the left ventricular end-systolic volume index, the presence of angina pectoris, and absence of symptoms of congestive heart failure were preoperative indicators of freedom from heart failure after coronary operations ($p < 0.05$).**

Conclusions. **Coronary artery bypass grafting for patients with moderate-to-severe left ventricular dysfunction is associated with acceptable long-term results. The left ventricular end-systolic volume index is a simple noninvasive method to aid in the preoperative decision making in such patients.**

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The number of patients with advanced left ventricular dysfunction who undergo coronary artery bypass grafting (CABG) has increased in the past few years [1]. Although the recovery of impaired myocardial function has been shown to occur after CABG, contractile left ventricular dysfunction remains a negative determinant of postoperative outcome [2]. Impaired left ventricular function, which has been shown to be an independent predictor of operative mortality in patients who undergo CABG [3], can also lead to low cardiac output and a high postoperative mortality rate [4]. Many patients with impaired left ventricular function require inotropic or mechanical support for hours to days after surgery [4]. In the last decade, an improvement in surgical techniques and perioperative management has led to a better postoperative course and decreased postoperative mortality and morbidity rates in this high-risk group of patients [5, 6].

Although surgical revascularization may be successful in the short term, little is known about the long-term results of successful CABG in patients with coronary artery disease and left ventricular dysfunction [7]. However, certain high-risk subgroups of patients remain at increased risk for complications and death despite progressive advances in perioperative care and myocardial protection [8]. We prospectively studied 75 patients with moderate to severe left ventricular dysfunction who underwent primary elective CABG between 1997 and 1999. Immediate and short-term results have shown the safety of CABG in this group of patients [9]. Our study presents the long-term outcome in this group of patients with regard to clinical status and predictors of freedom from congestive heart failure (CHF).

Patients and Methods

Between July 1997 and March 1999, 75 consecutive patients with impaired left ventricular function who underwent CABG in Catharina Hospital, Eindhoven, the Netherlands, were enrolled in this prospective study of long-term outcome. This study was approved by the Medico-Ethical Review Committee, and an informed consent was signed by every patient before enrollment. The inclusion criteria

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Table 1. Preoperative Characteristics of Patients

Patients (n)	75
Age, y (mean ± SD)	64 ± 13
Male/female ratio	22/3
NYHA functional class, No.	
I	15
II	13
III	19
IV	28
Preoperative mitral regurgitation, No.	
No	46
Trivial	22
Mild	7
Preoperative Q-wave MI (>30 days), No.	46
Primary indication for operation, No.	
Heart failure	18
Angina	34
Both	10
Ventricular arrhythmia, No.	2
Critical anatomy, No.	11
LVESVI (mL/m^2)	
Mean ± SD (range)	86.09 ± 18.9 (61.6–134.2)
Median	78.4
LVEF, mean ± SD	0.322 ± 0.06
Repeat CABG, No.	8
Diabetes, No.	19
Hemodialysis, No.	4
COPD, No.	6

CABG = coronary artery bypass grafting; COPD = chronic obstructive pulmonary disease; LVEF = left ventricular ejection fraction; LVESVI = left ventricular end-systolic volume index; MI = myocardial infarction; NYHA = New York Heart Association.

were the presence of left ventricular dysfunction (ejection fraction [EF] ≤ 0.40), isolated CABG, and no acute myocardial infarction during the month that preceded the operation. Exclusion criteria were prior cardiogenic shock, emergency surgery, off-pump CABG, implantation of an intraaortic balloon pump, combined valve procedures, or a left ventricular aneurysmectomy. The preoperative characteristics of the patients studied are summarized in Table 1.

Table 2. Causes of Postoperative Death in the Study Subjects

Cause of Death	Patients, No.
Immediate mortality rate (hospitalized patients)	
Low cardiac output	1
Myocardial infarction	1
Mediastinitis	1
8-year mortality rate	
Cardiac cause	
Sudden death	2
Massive pulmonary embolism	1
Noncardiac cause	
Cerebral hemorrhage	1
Cancer	1
Total	8

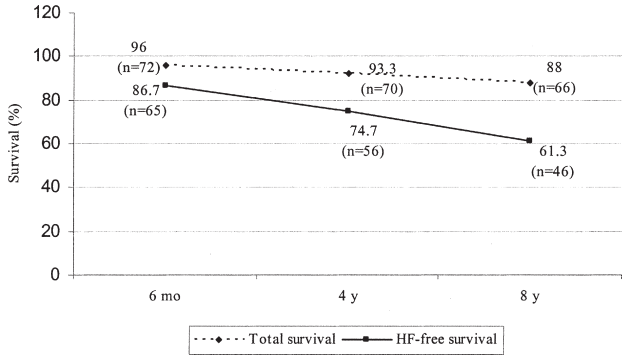

Fig 1. Total survival (dotted line) and freedom from heart failure (solid line) at the 4- and 8-year follow-up. (HF = heart failure.)

Preoperative Assessment

All patients with ventricular dysfunction (EF ≤ 0.40 on transthoracic-transesophageal echocardiography) and hibernating myocardium were studied preoperatively. The presence of this preserved myocyte functional activity was estimated by a transesophageal echocardiography stress test using dobutamine infusion according to dosages and infusion rates as previously described [10]. Hibernating myocardium was diagnosed if the patient had 5 or more reversible segments of the 16 myocardial segments [8], and 61 patients (81.3%) had preoperative evidence of hibernating myocardium.

Surgical Techniques

All patients underwent isolated CABG using cardiopulmonary bypass. A similar operative technique was performed throughout the study. After sternotomy and harvesting of the left internal mammary artery, saphenous vein, or in selected cases, the radial artery, or both, cardiopulmonary bypass was initiated with normothermic perfusion. Cold St. Thomas crystalloid cardioplegia was intermittently given through the aortic root. Complete revascularization was achieved in all patients. The mean cardiopulmonary bypass time was 74 ± 26 minutes, and the mean ischemia time was 55 ± 18 minutes.

Table 3. Cardiac Events at Follow-Up

Event	Patients, No.	Percentage
CHF symptoms	24	32
Ventricular arrhythmia	2	2.7
Infarction	5	6.7
Reoperation	0	0
PCI	3	4

CHF = congestive heart failure; PCI = percutaneous coronary intervention.