Results of Bilateral Internal Mammary Artery Use in OPCAB: Report of 200 Cases

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Abstract

Background- Skeletonized harvesting of the bilateral internal mammary arteries (BIMA) decreases the occurrence of sternal devascularization, thus decreasing the risk of sternal complications, while better patency rates improve survival in all patients.

Methods- From March 1997 to June 2003, 200 patients underwent bilateral skeletonized IMA grafting during off pump coronary artery bypass grafting (OPCAB). Of the 178 men and 22 women, 48 were older than 60 years, and 68 had diabetes (22 insulin, and 46 non-insulin dependent).

Results- Hospital mortality in the BIMA series was 1 patient (0.5 %). This patient had COPD. Early postoperative morbidity included bleeding in 2 patients (1%), mediastinitis in 2 patients (1%), low cardiac output in 2 patients (0.5%) requiring intra-aortic balloon-pump and perioperative myocardial infarction in one patient (0.5%).

Conclusion- Bilateral skeletonized IMA grafting is associated with satisfactory results not only in elderly patients but also in diabetic patients; however, it is not recommended in patients with chronic obstructive pulmonary disease ***(Iranian Heart Journal 2004; 5(4): 24-29).***

Key words: coronary artery disease■ coronary bypass■ off-pump heart surgery ■ internal mammary arteries

The internal mammary artery (IMA) is considered to be the best conduit in coronary artery bypass grafting (CABG) in terms of long-term patency and improved survival in all patients, including elderly patients [Galbut 1993]; therefore, the bilateral use of IMA (BIMA) is very desirable. Several studies have shown that long-term survival with bilateral IMA grafting is better than that with single IMA. Lytle et al. reported that the 10 and 15-year survival rates of bilateral IMA patients were 84% and 67%, respectively, compared with 79% and 64% for patients with single IMA (P<0.001). Reoperation and angina-free survival, as well as freedom from additional revascularization procedures, was significantly higher in the bilateral IMA subset [Lytle 1998].

In a study performed by Boxton et al., the 10-year actuarial survival rate of bilateral IMA patients was 86±3%, compared with 71±5% for a single IMA (P<0.001). In that report, the use of bilateral IMAs improved the rate of freedom from late myocardial infarction and reoperation. Schmidt et al. demonstrated that the survival benefit with bilateral IMA operations was achieved by grafting the IMA conduits to coronary arteries supplying the left ventricular rather than to the right coronary system. In our report, we describe the results in a non-selected group of patients. Complete grafting with bilateral IMAs with or without SVGs was the method of myocardial revascularization using off pump coronary artery bypass grafting (OPCAB) for patients of all ages.

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The purpose of this study was to analyze early and mid-term (up to 70 months) results of a series of 200 patients operated on with bilateral skeletonized IMAs.

Methods

From March 1997 to June 2003, 2434 patients underwent coronary artery bypass operations.
In this total population, the BIMA grafts series comprised 178 men and 22 women, ranging in age from 25 to 73 years. Patients with reoperation, gastroepiploic artery, free IMA or combined procedures were excluded from our study.
Coronary risk factors (Fig.1) in the series included hypertension (diastolic pressure greater than 90 mmHg) in 42 patients (23%), smoking in 91 patients (50%) hyperlipidemia in 86 patients (48%), hereditary coronary disease in 42 patients (23%) and diabetes mellitus in 68 patients (34%).

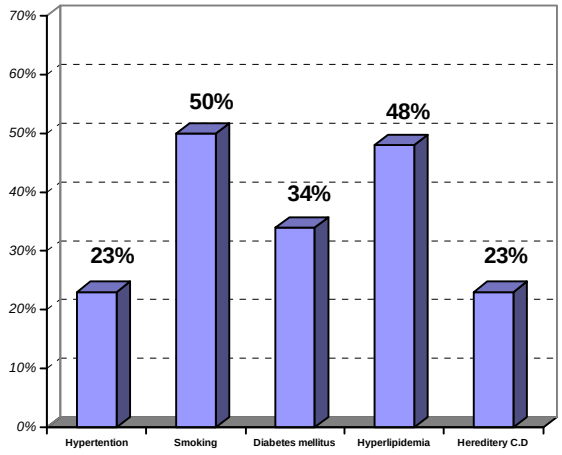

Fig. 1. Coronary risk factors

Clinical presentation in this series was unstable angina in 152 patients (76%) and previous myocardial infarction in 77 patients (38%). Two patients (1%) were asymptomatic with silent ischemia, discovered by routine examination and ECG with Q in inferior leads and positive exercise test was as well as thallium scintigraphy.
Bilateral varices was seen in 9 patients (5%) and 12 patients (6.6%) had bilateral stripping for varices.
Triple–vessel disease was present in 140 patients (70%), double-vessel disease in 60 patients (30%), and left main coronary artery stenosis was present in 15 patients (8.3%). Five patients (2.5%) had undergone previous angioplasty.
Ejection fraction, determined from left ventriculography, was greater than 50% in 161 patients (80%), between 40 and 50% in 31 patients (16%) and less than 40% in 8 patients (4%).

Operative technique

The IMAs were exposed through a standard median sternotomy incision using a Finochietto retractor.
The IMAs were mobilized extrafascially from the origin to beyond their bifurcation by low-voltage electrocoagulation, and the collateral branches were clipped. After heparinization, the distal end was divided.
OPCAB operations were performed with suction-type stabilizers and intra-coronary shunts (in 40% of LADs). The activated clotting time of 400 seconds was reached with a heparin dose of 150 U/kg body weight and was maintained between 350 seconds and 400 seconds. Hemodynamic stability during the operation was ensured with a regimen of inotropic drugs and warm fluid. A proximal sling was used prior to the arteriotomy and insertion of the coronary shunts (in necessary cases). We used coronary shunts in the cases with ST segment changes or arrhythmias. The distal anastomoses were sutured prior to the proximal anastomoses with continuous 7-0 polypropylene suture. The proximal anastomoses were completed with a Satinsky aortic tangential (side-biting) clamp.

Most frequently, the left IMA was anastomosed to the left anterior descending artery (LAD) with the right IMA on the right or circumflex coronary artery through the transverse sinus (Table I).

Table I: Coronary grafting and type of conduits

conduits	LAD	Diag.	LAD-Diag. (sequential)	CX	RCA
Left IMA	149	9	14	8	-
Right IMA	10	14	15	72	69
Saphenous Vein	-	28	-	68	51

Results

Mortality

Hospital mortality in the BIMA series was 1 patient (0.5%); this patient had COPD and the cause of death was mediastinitis, following post-CABG bleeding and reoperation.

Hospital complications

1. Bleeding: 2 patients (1%) had immediate reoperation for bleeding from the internal mammary anastomosis.
2. Mediastinitis: mediastinitis was observed in 2 patients with BIMA (1%), and they underwent reoperation with drainage and antibiotic therapy. One of them was a non-insulin dependent diabetic and the other was an insulin dependent diabetic.
3. Low-cardiac output: only one patient (0.5%) needed an intra-aortic balloon pump (IABP).
4. Perioperative myocardial infarction was observed in one patient (0.5%).

Discussion

In 1951, Vineberg and Miller reported the direct implantation of an IMA into the myocardium. In 1964, the first CABG with the IMA grafted to the LAD artery was performed by Kolesov in Leningrad.

The IMA graft has a superior early and long-term patency rate as compared to saphenous vein grafts, because of endothelium-derived relaxing factor as well as prostacycline. It is highly resistant to the development of arteriosclerosis; intimal hyperplasia does develop in the internal mammary graft and may be a cause for stenosis.

Patency of an IMA graft 5-12 years after surgery is 97% versus 46% for saphenous vein grafts. Also, the overall survival for hospital survivors after 8 years is compatible for the bilateral IMA (96%) and left IMA groups (92%).

Cosgrove and colleagues, while concluding that BIMA grafting did not increase hospital mortality but it increased surgical morbidity by a slight increase in the mean transfusion requirement, could not demonstrate a significantly better 8-year survival for BIMA in patients older than 60 years of age. Only in patients younger than 60 years of age did they demonstrate a significantly better survival after BIMA operations. One of the complications of the BIMA operations can be wound infection and mediastinitis.

The studies by sternal bone tomography performed by Carrier and colleagues indicated that IMA dissection might cause sternal devascularization and ischemia, resulting in sternal wound complications, which are more severe after double IMAs vs. single IMA mobilization. This devascularization was not greater among patients with diabetes mellitus, but the risk of sternal infection was increased by the use of an IMA graft, especially the use of bilateral mammary grafts in the presence of diabetes.

In another study, Kouchoukos and colleagues found a perioperative myocardial infarction rate of 2% in both groups, but late cardiac mortality was 1% in the BIMA and 3% in the single IMA group.

The number of pulmonary complications was not different between BIMA and single IMA groups. In most studies, only respiratory insufficiency is noted, varying from 2.1% to 8.3% for BIMA operations, depending on whether or not the pleural space is opened.

Recent studies, however, have demonstrated that this complication depends on the type of IMA harvesting; consequently, the skeletonized method can better preserve blood supply to the sternum.

In a clinical study on 100 patients, the authors investigated insulin-dependent diabetic patients undergoing revascularization with one IMA graft compared with those harvesting BIMA grafts. They found a reasonably low number of sternal infections in the single IMA (2.7%) group compared with the BIMA cohort (4%). In contrast, it was shown that patients with BIMA grafts exhibited a significantly improved long-term freedom from angina and event-free survival. These results are achieved with skeletonized IMA grafts; one can assume that, by using this type of meticulous preparation, intercostals arteries, and thus blood supply to the sternum, may have been better preserved.

The only significant risk factors for sternal infection were COPD and repeat operation. There is no significant difference in hospital mortality and morbidity between BIMAs or single IMA operations. Multiple regression analysis showed repeat operation and chronic obstructive pulmonary disease to be independent predictors of sternal infection.

Therefore, if an improvement in cardiac event-free and reoperation-free survival is to be expected, only in the presence of COPD should we withhold on operation using both IMAs.

We found no increased occurrence of deep sternal infection not only in diabetic patients compared with non-diabetic patients, but also between insulin and non-insulin dependent diabetic patients.

An age older than 70 years was not a risk factor for 30 – day mortality in our study; however, it was associated with a decreased late survival rate. The use of bilateral IMAs in the elderly is controversial.

In a study by Lytle et al., the number of patients older than 60 years operated on with bilateral IMAs was relatively small; nevertheless, bilateral IMA grafts improved the survival rate of patients older than 60 years compared with a single IMA graft.

The only large series (1467 patients) comparing bilateral with single IMA grafting in the elderly population was reported by Galbut et al. In this study, patients with BIMAs had lower hospital mortality rates (3.1%), compared with 6.4% for patients with a single IMA, and the late survival rate (mean 43 months) was better as well (69.7% versus 60.7%).

Conclusion

Bilateral skeletonized IMA and grafting is associated with satisfactory mid-term results. We do not recommend the use of this surgical technique in patients with chronic obstructive pulmonary disease (COPD). Morbidity is low, even in old or diabetic patients and mid-term survival is good. This technique may be used routinely in most cases referred for CABG.

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