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One-year angiographic results of left anterior descending bypass using internal mammary artery: a series of 48 consecutive patients

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Abstract

The left internal mammary artery (LIMA) has been used as a conduit for coronary artery revascularization since 1968. Here we are reporting a total of 48 consecutive patients were operated upon using double mammary arteries. All of them received a mammary graft to the left anterior descending artery (LAD). All 48 of them were controlled angiographically at 1 year postoperative to ensure satisfactory well-functioning grafts.

Keywords: Angiography, internal mammary artery, left anterior descending

INTRODUCTION

However, the using of the left internal mammary artery (LIMA), as a conduit for coronary artery revascularization since 1968 [1], has become regular and frequent in the last two decades as its long-term

benefits have become apparent [2–4]. Several studies have also shown improved long-term patency As patients with LIMA had better long-term survival, have fewer late myocardial infarctions and sustain a greater cumulative event-free survival. In the past, some doubts have been raised about the in-hospital outcomes and morbidity in patients who received LIMA compared with those who have received vein grafts. However, there have been several studies illustrating that the early outcomes are as good as, if not better, in patients who received LIMA [5–7]. Whereas the worldwide trend in the last two decades has been a steady increase in the usage of LIMA, not much is documented about the reasons for not using LIMA. it would be appropriate to consider LIMA to be the “gold standard” conduit of choice for surgical revascularization of the left anterior descending artery (LAD) [8].

MATERIALS AND METHODS

A total of 48 patients were operated consecutively between May 1989 and June 1990, using bilateral mammary arteries, the left

internal mammary artery (LIMA) bypassing the left anterior descending artery (LAD) in 45 of these patients, whereas Right internal thoracic artery (RIMA) was used to bypass the LAD in three of these patients (RIMA *in situ*).

- (1) The mean age of the patients was 56.7 years (38–66 years).
- (2) The male to female ratio was 42/6.

The preoperative symptoms were as follows:

- (1) Angina:
 - (a) Stage II: 13 (27%).
 - (b) Stage III: 17 (35.5%).
 - (c) Stage IV: 18 (37.5%).
- (2) Dyspnea:
 - (a) Stage II: 3 (6.2%).
- (3) Palpitation:
 - (a) 2 (4.2%).
- (4) Syncope:
 - (a) 1 (2%).

In this group of patients, the risk factors were as follows:

- (1) Hypercholesterolemia: 31 (64.5%).

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- (2) Smoking: 22 (46%).
- (3) Arterial hypertension: 21 (43.7%).
- (4) Diabetes: 4 (8.3%).
- (5) Obesity: 18 (37.5%).
- (6) Family history: 7 (14.6%).

A total of 23 (47.9%) of these patients had a history of previous myocardial infarctions:

- (1) Inferior: 14 (29.2%).
- (2) Anterior: 5 (10.4%).
- (3) Lateral: 4 (8.3%).

Coronary angiography showed the following:

- (1) 14 (29.1%) with left main disease.
- (2) 12 (25%) with two-vessel disease.
- (3) 36 (75%) with triple-vessel disease.

Only one (2%) patient had ejection fraction (EF) less than 35%, five (10.4%) patients had EF between 50 and 60%, and 16 (33.6%) patients had EF above 60%.

Historical aspects

In 1964, Spencer [1,2] was the first to use LIMA in coronary artery bypass grafting (CABG) in a controlled operative field, using hypothermic cardiac arrest, ensuring good long-term results.

In 1967, Kolessov [3] published on six cases of CABG using LIMA to LAD.

Green *et al.* [4,5] were the first to publish on a clinical series of LIMA to LAD in 1968 with excellent follow-up in 1970.

It is now clear that the systematic use of LIMA to bypass the LAD is accepted widely by the medical community [6-9].

Venous graft results

At 6 months, the occlusion rate of one venous graft per patient is 18.2% [10].

By the end of the first year, the rate of occlusion ranges from 16 to 26% and for the distal anastomosis, it ranges from 41 to 47% per patient [11-13].

By the end of the first to the fifth year, the occlusion rate ranges from 1 to 3%, reaching up to 4–5% per year; after the fifth year, this reached up to 54% at 10 years in the veterans administration study [11].

The mechanisms of deterioration of venous grafts are well known:

- (1) The platelet activation phase corresponding to the initial healing phase of the anastomosis because of the mechanical alterations of venous and arterial endothelia as well as the surgical manipulation are the main causes of precocious occlusion, especially at the distal anastomosis site.
- (2) The neointimal proliferation phase, which lasts for the first year (graft disease). This is accompanied by major alterations in the functional capacity of the graft.
- (3) The long-term phase, depending on the risk factors common to coronary artery disease, especially uncontrolled hypercholesterolemia [10].

Factors related to better long-term patency of internal mammary arteries grafts

The short-term patency of LIMA to LAD approaches 95%, whereas long-term patency approaches 90% (1 year) [14-17].

This may be because of the following reasons:

- (1) Small-caliber graft, matching the coronary artery caliber, resulting in faster flow with less stasis than in venous grafts, as well as less vascular turbulence because of a negligible geometric transition between the graft and the coronary artery.
- (2) In addition, mammary arteries do not have valvules or varicosities.
- (3) Also, its collagenous parietal structure can adapt to arterial pressure [18,19].
- (4) Also, the incidence of atherosclerosis in the mammary artery is very low [20,21].
- (5) Also, the mammary artery is a living graft [22,23].
- (6) In an anatomical study, Landymore *et al.* [24] reported that the mammary artery has little vasovasora, and depends on its nutrition by endoluminal diffusion, thus conserving the biological procedure of its nutrition after its usage as a graft, in contrast to venous grafts, which depend in their nutrition on vasovasora delivering oxygenated blood to their wall.

Potentially vital vascular mechanisms contributing toward better patency of mammary grafts are as follows:

- (1) Maintenance of vasomotor activity [25].
- (2) The ability to dilate according to myocardial needs of blood flow [22].
- (3) Preservation of endothelial integrity producing prostacyclins endothelium-derived relaxing factor (EDRF) and fibrinolysins [26,27].
- (4) The ability of the mammary artery to maintain a coronary-like flow (diastolic flow) proved by Doppler and late angiographic controls [20–30].

RESULTS

- (1) A total of 48 consecutive patients received 48 mammary in-situ grafts to LAD; 45 of these patients (94%) had LIMA to LAD and three (6%) had RIMA to LAD because of failure of harvesting LIMA.
- (2) All patients underwent double mammary harvesting.
- (3) Two (4.5%) patients were reopened because of bleeding.
- (4) One (2.2%) patient was reopened 2 weeks after the operation because of hemopericardium.
- (5) Only one patient needed prolonged extracorporeal circulation (ECC) assistance and was weaned off bypass using an intra-aortic balloon.
- (6) Two (4.5%) patients needed the temporary use of a pace maker.
- (7) Four (8.3%) patients needed prolonged inotrope infusion of more than 24 h because of low cardiac output.
- (8) Six (13%) patients developed AF that did not affect hemodynamics.

- (9) Three (6.5%) patients developed sinus tachycardia.
- (10) Two (4.5%) patients had ventricular extrasystoles that required an infusion of rhythm control drugs.
- (11) Four (8.3%) patients had perioperative myocardial infarction (MI), two of them in a nonbypassed territory.
- (12) One (2%) patient developed temporary right phrenic palsy.
- (13) Three (6.5%) patients had sternitis and were treated surgically as early as diagnosed.
- (14) One (2%) patient had a stroke and developed left regressive hemiplegia.
- (15) All patients had clinical and noninvasive controls at 3, 6, and 12 months.
- (16) All patients had angiographic control at 1 year to examine the angiographic results of all grafts.

The aim of this work was to analyze the mammary grafts to LAD angiographically at 1 year:

- (1) A total of 43 (89%) patients had angiographically perfect grafts to LAD (43 LIMA and 1 RIMA).
- (2) One patient (RIMA to LAD) had anastomotic stenosis, yet patient graft.
- (3) Two (4.5%) patients (LIMA to LAD) showed string sign of the graft.
- (4) Two (4.5%) patients had totally occluded grafts (RIMA to LAD, the other one LIMA to LAD).

Analysis

In this series, mammary grafts to LAD had a patency rate of 95.5% (46 patients).

We had two occluded grafts to LAD.

On examination of the coronary angiography of the two patients with string effect as well as one of the obliterated grafts, we found that the initial lesions were insignificant, creating a competitive flow countering the graft flow. We attribute this either to initial overestimation of the severity of the lesion (poor indication) or to regression of lesions postoperatively by strict control of risk factors, especially the aggressive use of statins.

In brief, out of 48 mammary grafts to LAD, only 4.5% were totally occluded (two patients), whereas 46 (95.5%) grafts were patent, of which three (6.6%) grafts were unsatisfactory.

CONCLUSION

The routine use of mammary grafts, especially LIMA, is mandatory to bypass the LAD.

Double mammary harvesting did not increase the risk of sternitis in this series, neither the risk of postoperative bleeding, taking in consideration doing a thorough hemostasis.

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Conflicts of interest

There are no conflicts of interest.

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