

SEQUENTIAL INTERNAL MAMMARY ARTERY GRAFTING EXTENDED USE OF A SUPERIOR CORONARY BYPASS CONDUIT IS IT SAFE

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SUMMARY

Use of sequential internal mammary artery (IMA) grafting is a possible method of improving long term patency in patients receiving coronary artery bypass grafts. Patients who had sequential IMA grafts are reported. Age ranged from 40-63 years. 9 patients had three vessel disease and one each had single vessel and left main trunk disease. Only one patient had unstable angina. Mild LV dysfunction was present in 2 and moderate LV dysfunction was seen in 1. Left internal mammary artery was anastomosed side to side to diagonal and end to side to LAD in 8 and 3 patients had sequential IMA grafts placed proximally and distally to left anterior descending in the presence of tight proximal lesion and disease in its midportion. There was no operative death and no evidence of left ventricular failure. None of the patients suffered perioperative myocardial infarction and/or return of angina. All the patients underwent postoperative ETT within 60 days of operation which was normal in all. Graft visualization in 8 out of 11 patients postoperatively showed patent grafts without kinking or narrowing. These findings suggest that sequential IMA grafting is safe and should improve overall long term patency of coronary artery bypass graft. We recommend this procedure particularly for the younger patients.

INTRODUCTION

Early obstruction of IMA from intimal hyperplasia or later narrowing from atherosclerosis is uncommon. 7-10 years of patency of IMA has been found to be 90-95%.^{1,2,3} Campaeu⁴ reported presence of atherosclerosis in 46% of vein grafts 10 years after operations. Late failure of saphenous vein grafts was determined by Loop⁵ et al to be the reason of repeat revascularisation in 40% of patients undergoing reoperation in 1981 and 1982.

Since attrition for patients with saphenous vein grafts far exceeds that with IMA graft, it would seem that performing more IMA grafts could improve survival after coronary artery bypass grafting and decrease

the recurrence of coronary events and the subsequent need for reoperation.

Sequential grafting with internal mammary artery is one way a surgeon might increase the number of coronary vessels bypassed with arterial grafts.

If flow in the sequential IMA grafts is sufficient and the graft are technically feasible, these bypass conduit should play a vital role in improving results of coronary artery bypass grafting. Since there is no accurate method to demonstrate that flow in IMA or saphenous vein graft is sufficient to properly perfuse the ischemic area of myocardia at the time of surgery, cardiac surgeons have had to rely on indirect measures. These include death at operation,

TABLE – I

| NYHA Functional Class | No. of patients |
|--------------------------------|-----------------|
| II | 9 |
| III | 2 |
| IV | 0 |
| LVEDP > 25mmHg | 0 |
| LVEF (<40%) | 1 |
| No. of vessels | SVD 2 |
| | 3VD 9 |
| Diabetes Mellitus | 3 |
| Previous Myocardial Infarction | 3 |
| Hyperlipidemia | 2 |
| Essential Hypertension | 3 |

low cardiac output secondary to LV failure, perioperative myocardial infarction, postoperative stress testing and early return of angina. These factors will be reviewed in 11 patients who underwent sequential internal mammary artery grafting.

MATERIAL AND METHODS

Patient characteristics

11 patients were selected for sequential IMA grafting during the period between March 93 and August 95. The operations were performed at PIC (Punjab) and NICVD (Karachi) by the senior author. The decision to undertake sequential IMA grafting was taken after reviewing the preoperative coronary angiogram. The age ranged from

40 to 65 years, and all were males. Table-I gives their preoperative clinical profile.

Study Protocol

All patients had ECG and cardiac enzymes assay performed postoperatively in the ICU and the need for inotropic support was also recorded.

In the late postoperative period after discharge from the hospital, ETT was performed in all patients within 8 weeks of operation. In addition, 8 patients had angiography.

Diagnosis of perioperative myocardial infarction was made if

- i. ECG showed any new Q wave,
- ii. CK-MB fraction was raised > 50 iu/L.

Low output state was defined as inotropic requirement for > 48 hours or need for an intra aortic balloon pump.

Surgical Technique

All operations were performed by a standard surgical technique. After median sternotomy, LIMA was harvested from its origin from the left subclavian artery right upto its bifurcation at the lower border of the 6th rib. The IMA was not skeletonised (it was taken down along with venae comitantes and pierce of endothoracic fascia). All intercostal branches were carefully controlled with hemoclips; special precaution was taken to clip the highest intercostal branch (to first intercostal space).

TABLE – II

| | LIMA | LIMA | LIMA | Total Patients |
|-----------------|------|------|------|----------------|
| Side to Side | Diag | Ri | LAD | |
| End to Side | LAD | LAD | LAD | |
| No. of patients | 7 | 1 | 3 | 10 |

TABLE – III

| Grafts | No. of patients |
|--------------------|-----------------|
| LIMA only | 2 |
| LIMA + vein | 1 |
| LIMA + 2 vein | 5 |
| LIMA + 3 vein | |
| LIMA + RIMA + vein | 3 |
| Total patients | 11 |

All pericardial and pleural and thymic branches were diathermised, and the pleural space was regularly entered. The LIMA was brought through a slit in the pericardium close to the base of the heart, so that it would not be kinked by the expanding lung. LIMA was laid parallel to the phrenic nerve.

The operation were done after instituting CPB with single two stage cavoatrial venous and aortic cannulation at 28°C. LV was vented through the aortic root needle, and cold crystalloid cardioplegia of the St. Thomas' type was given through the same aortic root needle as was used to vent the heart. All distal anastomoses were constructed during the single aortic cross clamping, followed by fashioning of top end with the aorta unclamped.

The distribution of the sequential grafts is given in table-II.

All patients received vein grafts in addition to IMA. In 3 patients right internal mammary artery was also dissected. In 2 it was free RIMA. The distribution of grafts is given in table-III.

RESULTS

Mortality = 0

The complication which were seen are given in table-IV.

All ETTs were negative.

The postop coronary and IMA angiogram were normal. All grafts were patent. Sequential anastomoses were functioning nicely. LV function on postop echocardiogram showed improvement in 3, and deterioration in one.

DISCUSSION

Studies of long term (10 years or more) survival after coronary artery bypass grafting confirm the importance of complete revascularisation at the time of initial operation and suggest that atherosclerotic occlusion of saphenous vein grafts is a major cause of recurrent angina and myocardial infarction.^{6,7} During the first five postoperative years the risk of occlusion of saphenous vein graft is approximately 1-3% per year, but the average attrition rate increase 2-5 times between 7 to 12 years postoperatively.⁸ In the series of Campeau⁴ et al, 44% of vein grafts that were patent one year after surgery were occluded by 10-12 years. In addition in 46% of vein grafts there was evidence of atherosclerosis on angiography.

These late result with saphenous vein grafts contrast sharply with excellent long term patency of the IMA grafts. Recently Lytle⁹ et al reported the results of serial angiographic examination of grafts in 137 patients who underwent IMA bypass procedure and found that among patients studied within 5 years of operation, 97% of the grafts were patent. 7.5 years or more after operation, 93% of grafts were patent.

TABLE – IV

| | |
|-------------------------------------|---|
| Perioperative Myocardial Infarction | 1 |
| Pneumonia | 1 |
| Gastrointestinal Bleeding | 1 |
| Low Output State | 2 |
| Superficial Wound Infection | 2 |

Most previous series of patients undergoing bypass with IMA report single distal anastomosis, despite this limitation, late survival with IMA grafts appears improved,^{10,11,12} thus correlating with the data on better patency compared with that of patients receiving saphenous vein graft alone.

Stimulated by these and other studies,^{13,14,15,16,17} IMA grafts have been used to bypass multiple coronary artery lesion and it was speculated that such a strategy should further improve the late patient survival and functional results. This review of small number of patients focuses on early operative morbidity and mortality, and patency of IMA grafts used as sequential grafts.

The present series of patients is broadly representative of patients currently undergoing bypass procedures. Mean age was 52, and only one patient was in NYHA functional class III or IV. In addition the present series represents our learning curve.

There has been concern about nonfatal complications associated with IMA graft. Preparation of IMA and the creation of multiple anastomoses does require more operative time than would be required with saphenous vein bypass grafts.¹⁸ However, this extra time did not result in additional myocardial injury. The 6% incidence of periop MI compares favorably with 4.1% incidence reported from a large multi institutional study of patients undergoing coronary revascularisation in 1979, primarily with saphenous vein grafts.¹⁹

Previous reports¹⁴ of the patency of IMA bypass graft contain a large number of patients with single grafts to the LAD, or one of its major branches. We do not believe that these data could be extrapolated directly to patients with sequential IMA grafts. For this reason, we performed early angiography in 8 out of 11 patients. The 100% patency of distal anastomoses indi-

cates that the expanded use of IMA does not jeopardise graft patency.

The principle of sequential grafting for coronary revascularisation is well accepted and widely utilised. Its principal advantage as applied to saphenous vein related to its ability to provide flow to a small coronary artery which would not have adequate flow capacity to support its own graft, without a high likelihood of graft closure.²⁰ Additionally, the use of sequential graft will expedite the operation by decreasing the number of proximal anastomoses and make optimal use of saphenous vein if adequate length of high quality vein is not available.

The primary reason for use of IMA as a sequential graft is different and is based on its freedom from intimal proliferation and atherosclerosis and better long term patency. Because of its demonstrable patency in low flow situation, there is no need to increase runoff by providing a second anastomoses.

Technical considerations involve placing the IMA intrapleurally, parallel to the phrenic nerve, incisioning the pericardium to the left at the base of the heart so that IMA has nearly as straight course from its origin to the anastomosis. The position of the two anastomoses must be such that kinking, torsion and tension of the IMA are avoided.

The initial fear that IMA may not provided sufficient flow to the myocardia^{22,23} has been overcome by studies that reveal adequate flow through the grafts and relief of symptoms during exercise similar to that produced by vein grafts. In short IMA is capable of supplying the need of the myocardium even when perfusing large area through sequential grafts. This is not surprising, since several investigations have presented angiographic evidence of dilation of IMA grafts after being anastomosed to coronary arteries.

There are many different sites and combination of sequential IMA grafts.

Except in special circumstances we do not recommend bypassing two major coronary arteries (e.g. LAD and Circ-marginal) with the same IMA graft. The most frequent sequential graft is side to side to diagonal and end to side to LAD. This combination allows the surgeon to bypass the moderately stenosed diagonal when the LAD is critically stenosed proximal to the origin of diagonal without fear of a saphenous vein graft causing too much flow that results in shrinkage of IMA.

The LIMA can be placed proximally and distally to LAD when there is a light proximal obstruction and disease in the midportion. This may be a better option than carrying out endarterectomy of LAD, which carries increased chance of perioperative MI.

CONCLUSION

The sequential IMA grafting is a technique by which extended use can be made of a conduit demonstrated to be superior to saphenous vein. The creation of sequential anastomoses does not increase the risk of perioperative myocardial infarction and is safe. Long term patency of the anastomoses are likely to be sustained if certain technical factors are taken into consideration. We would recommend this procedure strongly in young adults. Best results are obtained when sequential anastomosis is created between LAD and diagonal vessel, although Cx marginals can also receive sequential IMA graft.

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