Extending the use of autologous arterial conduits in myocardial revascularisation

Anastomosis of the left internal mammary artery to the left anterior descending coronary artery gives excellent long-term patency and improved early and late survival with few myocardial infarctions and reoperations.1-3 The advantages of using the internal mammary artery operate irrespective of age, sex, degree of left ventricular dysfunction, pattern of coronary disease, and surgical caseload.4-6 The apparent benefits of a single internal mammary artery graft made it both inevitable and appropriate that more extensive use of autologous arterial conduits should be evaluated to determine whether it would result in additional improvements in late morbidity and mortality. Use of both internal mammary arteries for grafts, including free and sequential grafts, has been the most commonly applied technique.7-9 The right gastroepiploic10 and inferior epigastric arteries11 have also been used successfully. So far large groups of patients with these alternative conduits have not been evaluated.

The case for the more widespread application of multiple autologous arterial grafts can be considered in three broad areas: (a) operative technical factors; (b) early morbidity and mortality; and (c) late survival of grafts and patients, cardiac events, and freedom from reoperation. If both internal mammary arteries are used, sequential anastomoses and free grafts12-15 and lengthening procedures where necessary,16 multiple distal coronary anastomoses may be fashioned to virtually any point in the coronary system.17 However, these procedures are technically more demanding and require longer operating times than do single internal mammary artery grafts.17

The rate of early re-exploration for haemorrhage tended to be increased in the learning period;14 however, experience and attention to particular aspects of haemostasis reduced this problem.5,15 The reported association between grafting for saphenous vein and bilateral internal mammary grafting is a major cause of concern.18-22 Kouchoukos et al reported infection rates of 1-9% and 6-9% for single and double mammary grafts respectively.17 In a prospective study, Grossi et al reported similar results.18 These data contrast with the series from the Cleveland Clinic in which the infection rate was 1% in patients with vein grafts, 0-9% in patients with a single mammary artery graft, and 1-7% when bilateral mammary artery grafts were used.19 In all these studies,16-19 however, there was a significant increase in the infection rate in diabetic patients given bilateral mammary artery grafts. It seems possible that the problems of increased pleuropulmonary morbidity,20 chest wall pain,21 shoulder girdle pain,22 and brachial plexus injury23 reported with single mammary artery grafting may increase with widespread use of both mammary arteries.

Because the early mortality for coronary artery surgery is low (2-3%),24 it is not surprising that the addition of multiple internal mammary artery grafts did not improve survival.25 More noteworthy is that despite the increased complexity of such operations there was no detrimental effect on early survival.25 The possible late benefits of bilateral internal mammary grafts remains to be established.7,10 A prospective trial to compare multiple mammary artery grafting with a single left internal mammary artery to the left anterior descending coronary artery and additional saphenous vein grafts showed no difference in survival at four years.7 However, in observational studies with a 10-15 year follow up patients with bilateral internal mammary artery grafting had a survival advantage and fewer late cardiac events and reoperations.26-28 Though these studies may be criticised because of their selection bias and the relatively small numbers, it is nevertheless difficult to ignore these apparent benefits.

The long-term follow up data from the Cleveland Clinic group, whose previous work had such a profound effect on surgical practice worldwide, will be of great interest. Why is the internal mammary artery protected from intimal thickening before as well as after it is used as a bypass graft? Should we expect the same freedom from degeneration and late occlusion in other arterial conduits? The mammary artery has a denser internal elastic lamina than is almost perfectly formed at an early age.27 It does not show evidence of discontinuities containing smooth muscle cells from the media.27-28 The media is primarily elastic with scanty smooth muscle cells.28 Occasional intimal thickening is seen but this usually consists of matrix covered by endothelium.27 It has been postulated that an internal elastic lamina with no fenestrations can suppress intimal thickening.27 This may be the basic reason for the longevity of the mammary artery graft. In contrast the intimal elastic lamina of the gastroepiploic and inferior epigastric arteries show fenestrations and the media is rich in smooth muscle cells and relatively poor in elastin.28 There are fewer discontinuities, however, than in the saphenous vein, which suggests an intermediate tendency for intimal thickening to develop.27,28

The low incidence of atherosclerosis in the mammary artery is probably related to its ability to release vasoactive substances29-30 capable of protecting the vascular wall from platelet adhesion and aggregation and from vasospasm.31,32 Concentrations of prostacyclin33 and endothelium derived relaxing factor34 are higher in the mammary artery than in the saphenous vein. The endothelium of the gastroepiploic artery also secretes more of the vasoconstrictors and inhibitors of platelet activity.33-34 This may indicate the strong likelihood of an acceptable long-term patency rate.
for this conduit. There is no information on the biochemical properties of the inferior epigastric arteries.

Advocates of the use of the right gastroepiploic and inferior epigastric arteries showed that these conduits can be used with good early results and minimal increases in operating time and morbidity. Though some reservations about a more liberal use of these alternative conduits are warranted their role in routine myocardial revascularisation merits further evaluation. When other autologous conduits are scarce they may prove invaluable.

In 1989 in the United Kingdom less than 4% of patients undergoing myocardial revascularisation had bilateral internal mammary artery grafting whereas 60% had single internal mammary artery grafting. No information is available on the use of the gastroepiploic and inferior epigastric arteries. Widespread use of arterial conduits depends on the long-term survival and freedom from angioplasty and reoperation after their use. This information can only be obtained by careful audit of surgical results and appropriate clinical trials. This may provide the necessary stimulus to surgeons and hospitals to accept the increased complexity, operation time, and surgical expertise required to extend the use of autologous arterial conduits in myocardial revascularisation.

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