Regular Review

Coronary bypasses

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Remarkably quickly, coronary bypass surgery has become one of the operations familiar to the general public. The news that the operation takes away pains in the chest and the need for drugs has travelled from the Athenaeum to working men's clubs. The operation has been shown on television and has been rendered fashionable by Arab princes, American generals, British politicians, and other public figures. No wonder the man in the street with heart trouble is asking if he can have one too.

The demand shows no sign of abating. In 1980 some 137 000 Americans had the operation; here in Britain demand is only beginning to take off, yet cardiac units are being overwhelmed by coronary work. In response to growing waiting lists the Department of Health has suggested that coronary surgery should be given priority.¹ Is that wise?

Background

Surgical procedures for the relief of angina pectoris have included all sorts of ingenious manoeuvres, such as introducing talc into the pericardium or ligating the internal mammary artery, with the intention of promoting collateral blood flow to the myocardium. The proponents of these and other procedures were enthusiastic, but the sceptics designed objective experiments: the improvement in angina and exercise tolerance that resulted from two small parasternal skin incisions designed to reveal, but not ligate, the internal mammary artery was perhaps the most memorable.² The placebo effect of this sham operation (which might have run into difficulties with a modern ethical committee) ensured that Vineberg's technique of implanting the internal mammary artery into the myocardium³ had a lukewarm reception, though there was some evidence of objective benefit.⁴

The development of selective coronary arteriography at the Cleveland Clinic⁴ tempted surgeons to approach the arteries directly. Endarterectomy was soon surpassed by aortocoronary bypass grafting using lengths of reversed saphenous vein.⁵ This procedure brought about an immediate increase in blood flow to the myocardium—and relief of angina which correlated well with graft patency.⁶ It rapidly caught on.⁷ The results improved with experience and refinements, such as the use of multiple grafts to ensure complete revascularisation and cold cardioplegia during surgery to protect the myocardium. Nowadays the technique is so standardised and safe that patients may expect to be home two weeks after surgery and working again after about two months.

Selection

The selection of patients for bypass surgery is determined by their symptoms and by the state of their left ventricle and coronary arteries. The prime indication is angina pectoris refractory to medical treatment. Virtually all published reports have used this clinical characteristic as a starting point, a fact which must be kept in mind when interpreting the results. But what does refractory mean? Most patients can avoid mild or even moderate angina by slowing up or by taking glyceryl trinitrate beforehand. So does an inability to walk fast or run upstairs qualify? The decision has to be subjective; but as the operation has become safer so this judgment has been relaxed. Anyone whose life is at all limited by angina despite medical treatment should be considered for surgery.

Patients with unstable angina (rest pain without infarction or coronary insufficiency) generally settle down with medical treatment. Emergency surgery confers no benefit and may provoke infarction.⁸ After the acute episode many patients will require elective surgery for continuing angina. Likewise, myocardial infarction is not a usual indication for surgery unless there is subsequent angina. Cardiac arrhythmias and heart failure are not indications for bypass grafting, though other surgical procedures may help.

Poor left ventricular function increases the risk of coronary bypass surgery; it is a relative contraindication. Patients with severe angina and damaged ventricles may, however, merit surgery both for humanitarian reasons and because the presence of angina implies reversible ischaemia. The increased operative risk is often acceptable to the patient, if not the surgeon. Diffuse coronary disease is another relative contraindication because the technical difficulties result in less satisfactory myocardial perfusion.

The ideal candidate has stable angina pectoris refractory to medical treatment, normal left ventricular function, and large coronary arteries with a discrete proximal lesion. Sometimes the unlikely candidates may be identified on clinical grounds—for example, diabetics commonly have stringy arteries; radiological evidence of cardiomegaly or extensive electrocardiographic Q waves suggest poor left ventricular function. But coronary arteriography is essential for certainty. This investigation is very safe in experienced hands. Most British centres have complication rates similar to the American collaborative study, which reported a 24 hour mortality of 0.11% and very low morbidity due mainly to myocardial infarction (0.25%) and local damage to the femoral or brachial arteries (0.7%).⁹ The investigation invariably includes left

heart catheterisation and left ventricular angiography, and takes about half an hour. It can be undertaken on day cases, though most patients are admitted to hospital for a day or two. So valuable has this investigation become that many cardiologists now feel uncomfortable managing patients with ischaemic heart disease without a knowledge of the coronary anatomy. Only the practical consequences of investigating everybody deter us.

Results

The operative mortality has gradually fallen over the years. The Veterans Administration and European trials of coronary artery surgery, which recruited patients in the early and mid-1970s, reported mortalities at 30 days of 5.8% and 3.6% respectively.^{10 11} More recently figures of 1.3%¹² and 2.3%¹³ have been reported.

The morbidity is low. There is little damage to the myocardium during the operation; some 5% of patients develop new electrocardiographic Q waves.¹⁴ Transient supraventricular arrhythmias are common in the early postoperative days. More serious, though fortunately rare, complications include wound infection, pulmonary embolism, and, very occasionally, cerebral damage and stroke. Discomfort from the thoracic cage is usual and lasts several weeks, as does undue fatigue, a universal and unexplained consequence of cardiopulmonary bypass. As might be expected, complications are more common in older patients.¹⁵

About 60% of patients experience complete relief of angina after surgery and 85-90% are improved.¹² The popular impression is correct. Women fare less well because their coronary arteries are small.¹⁶ It is easy to believe a recent suggestion that symptomatic relief correlates best with body size,¹⁷ big hearts being easier to operate on.

Symptomatic benefit has been corroborated by objective tests¹⁸: exercise capacity, as measured by treadmill or bicycle ergometry, is improved; myocardial ischaemia during stress is lessened as judged by thallium imaging or lactate extraction. Any effect on resting ventricular function is probably negligible unless there is perioperative myocardial infarction; but exercise induced abnormalities of left ventricular wall motion disappear as judged by radionuclide ventriculography.¹⁹ Elective recatheterisation has shown that 90% of grafts are patent at one month and 80% at one year. Early occlusion is due to thrombosis; late occlusion is due to fibrous intimal proliferation.²⁰

Angina recurs in some 2-4% of patients a year¹² and may be due to occlusion of the graft or progression of the native disease. Efforts should be made to counter the latter by encouraging patients to stop smoking, eat a prudent diet, and take regular exercise. There is some evidence that drug treatment will reduce the tendency for the graft to close,^{21 22} but patients dislike taking tablets and, as with all such drug trials, most receive treatment needlessly. The evidence is not strong enough to recommend treating everyone.

Coronary bypass surgery improves the quality of life to the extent that patients can return to work.^{23 24} Many do not.^{25 26} Patients often lose time from work after the onset of angina, and the spectre of heart disease provides today's employer with an additional excuse for reducing his work force. So while a return to work may be unrealistic many will enjoy their retirement more after bypass surgery. There is no reason to advise men to retire on grounds of ill health without considering them for surgical treatment.

Survival

The survival of patients with coronary artery disease is governed by the extent of the disease: the more extensive the disease, the worse the prognosis.²⁷ The anatomical extent is difficult to quantify because much depends not only on the site of a lesion but also on its severity, length, the presence of collaterals, and so on. The concept of defining the extent of coronary disease by the number of vessels affected is simple and practical albeit imperfect. The left main stem divides into circumflex and anterior descending branches, with the right having a separate origin. In most patients the three vessels supply roughly equal segments of myocardium.

Common sense suggested that bypass grafting might improve survival in patients with more extensive disease. This has been shown in two randomised trials, which have had a profound effect on cardiologists' thinking. The Veterans Administration study comprised 686 men. Four years after surgery more patients with lesions of the left main stem were alive than in the comparable group continuing with medical treatment.²⁸ The notion that patients with this lesion must have surgery was, and is, difficult to resist. The European study, which included six British centres, reported similar findings but the numbers did not achieve statistical significance. This study did show, however, improved survival at five years in patients with three vessel disease, a finding which has subsequently received support from the Veterans Administration study.¹⁰ Neither study showed any difference between medically and surgically treated patients with disease confined to one vessel: survival was excellent. Patients with two vessel disease formed an intermediate group: survival was improved if the proximal portion of the left anterior descending artery was affected.¹¹ Other trials in which the patients have not been randomised have pointed in the same direction.^{29 30}

So the patient with extensive coronary disease is somewhat safer having bypass surgery rather than continuing with medical treatment.

Implications

The success of coronary bypass surgery has far reaching implications. The investigation and surgical treatment of symptomatic coronary disease are not temporary fashions. Despite our hope that the incidence of coronary disease will decline as people modify their life style, there is little evidence of this happening in Britain as yet. So the Department of Health can be applauded for recommending an increase in the facilities for patients with coronary disease provided health authorities can translate this recommendation into action. The considerable medical and economic burden must be borne since the chief beneficiary will be the working man.

There are implications for the asymptomatic patient. Many men are incubating coronary disease. Suppose they are identified from abnormal electrocardiograms and exercise tests before they develop symptoms, like some American servicemen?³¹ If investigation shows left main stem disease, should they not have surgery too? Some do. This may be justified if there are abnormalities on exercise testing, since those with positive test results are more likely to die prematurely³²; possibly such men do not admit to or cannot feel angina. On a more practical note, additional bypass grafting for asymptomatic coronary lesions is commonly recommended if heart surgery is being undertaken for other reasons such as valve replacement. Proof of long term benefit is lacking, but the additional procedure carries no increased risk and seems

reasonable when the lesions look sinister. Asymptomatic patients with advanced coronary disease have also been offered medical or surgical treatment after recurrent myocardial infarction, but no differences in survival have emerged so far.³³ Heart surgery for asymptomatic coronary disease may not be as ridiculous as it seems at first, but this sort of scientific logic must always be tempered with clinical judgment.

There are social implications too. Men disabled by angina are dependent on others, their zest for life is dulled by beta blockade, they become depressed, and they lose their self respect. Surgery is a wonderful restorative, almost a cure. An individual whose livelihood depends on a healthy heart—a

pilot or lorry driver, for example—might reasonably question whether his apparent cure is legally valid. By this means six American aviators have had their flying licences restored after successful bypass surgery,³⁴ and similar court cases are under way in Britain. The conclusion is plain and unequivocal: men with angina pectoris and advanced coronary artery disease whose symptoms persist despite medical treatment should be offered bypass grafting.

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