

## CRITERIA FOR SELECTION OF PATIENTS FOR MYOCARDIAL REVASCULARIZATION

By H. J. C. Swan

It must be clearly understood that myocardial revascularization is not the cure for atherosclerotic coronary heart disease. The etiological factors responsible for the pathological process of atherosclerosis are unaltered and the particular factors which favor localization of obstructive lesions at specific sites in the coronary tree at best remain unchanged. Such surgical procedures can, however, ameliorate the symptomatic and objective consequences of coronary artery disease in favorable anatomical circumstances: they cannot cure coronary atherosclerosis nor is it likely that they slow its progression.

It can now be stated with certainty that successful operation can achieve the complete relief of angina pectoris in certain patients previously highly disabled by reason of exertional chest pain<sup>1,2</sup>. In other patients partial relief of this symptom has been achieved with an increased exercise tolerance prior to the onset of symptoms manifest by a higher heart rate achieved by cardiac pacing, then could be attained in comparative preoperative studies<sup>3</sup>. Successful vein bypass grafting can improve or restore to normal ventricular function when this has been seriously disturbed by reason of ischemia<sup>4</sup>. The end-diastolic ventricular pressure is reduced to the range of normal; the ejection fraction—if previously depressed—may also be normalized; defective segmental wall motion can be corrected<sup>5</sup>; and abnormal stiffness (decreased compliance) can return to normal levels. Clearly if no objective evidence of ventricular dysfunction—akinesis, dyskinesis, etc.—has been demonstrated preoperatively then it is not to be expected that a further improvement in function will be found.

At the present time there is no data on the effect of this operation on the duration of survival for the global population of patients with coronary heart disease. Neither is there evidence to indicate that the operation will prevent the occurrence of an acute myocardial infarction or reduce the size of a myocardial infarction should one occur. While such data will be difficult to obtain in a disease of such heterogeneity as coronary heart disease, however, individual patients apparently at high risk have been successfully restored to normal function and have survived for some years beyond that which might be reasonably expected.

Adverse consequences of vein bypass grafting include operative mortality which is small in the hands of experienced surgeons (2-8%)<sup>6</sup>. The morbidity following vein bypass graft surgery is also small but pulmonary complications may be anticipated in patients with chronic pulmonary disease or a long history of cigarette smoking. Postoperative myocardial infarction is not a rare complication and may occur in up to 10% of patients. Postoperative myocardial infarction may be most frequently identified in patients with severe diffuse distal disease in which the magnitude of coronary flow transmitted by the already diseased vessel is

markedly reduced. Late graft closure due either to alterations in the vein itself or at the points of its anastomosis to the aorta or coronary artery has been reported in 10 to 15% of cases. Graft closure is frequent when the measured graft flow is less than 20 ml/min<sup>7</sup>.

In this regard the operating surgeon must clearly play a major role. The selection of the site of implantation of the graft into a previously diseased vessel is a matter for not a little technical skill and judgment. The assumption that this task can be accomplished with equal facility by all cardiovascular surgeons is totally unwarranted. In fact, the variability between the results of different groups seems to ignore this all important factor which may prove to be the principle determinant of the long term fate of the anastomosis. Anastomosis of the internal mammary artery to the anterior descending coronary artery is not usually associated with late graft closure. In addition, while there is a significant incidence of early graft closure, the majority (70+) of grafts appear to be open at one or two years. Since biologically the grafted vein appears to remain patent, failure of graft patency is likely to be due in significant degree to error of selection or technique employed on the particular vessel or vessels selected for anastomosis.

The strongest indication for vein bypass graft surgery in obstructive coronary artery disease is in those patients who are at the highest risk, yet with the most favorable anatomic features. Thus, patients with critical or sub-critical lesions in the left main coronary artery or high in the anterior descending coronary artery, with normal distal coronary vessels would prove to be the patients who would stand to benefit the most from operative intervention. The term critical lesion is deserving of some elaboration. Present techniques may not allow for the designation of the degree of obstruction to be accurately stated from cineangiography. Because of the irregular shape of coronary occlusive lesions, the differential contrast which pertains to viewing of contrast filled vessels against varying tissue density background and many technical factors probably does not permit an accurate statement of the degree of narrowing of the coronary vessels to within 10 to 15%. Thus, a crescent shaped lesion which would appear to occlude 95% of the vessels lumen when viewed from one projection may in fact be only responsible for 75-80% true narrowing. The degree of narrowing is quite critical since a material reduction in blood flow does not usually pertain in the human vascular system unless the vascular structure has been narrowed to approximately 70% of its normal size, as for example in valvular stenosis, aortic coarctation, or occlusive peripheral vascular disease.

It is, therefore, necessary before one makes a judgment on the critical degree of vascular narrowing to have supportive evidence to guide one as to the severity of the obstruction. At the present time most physicians would require the relation of symptoms—angina pectoris, dyspnea, fatigue, either at rest or during stress to obstructive coronary artery disease before one can be certain that the degree of narrowing is critical.

Since the factors responsible for progression of such lesions are not well understood at present we cannot predict the rate of progression of narrowing if it is at a sub-critical level. Hence, many cardiologists are reluctant to recommend surgical treatment for patients with moderate anatomical lesions who do not have symptoms of cardiac ischemia.

The important anatomical factors in regard to vein bypass grafting are listed in Table I. Before any deci-

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TABLE I  
ANATOMICAL FACTORS

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1. Location: L.C.A., L.C.F., L.A.D., R.C.A.  
— single, multiple  
— proximal, distal, both
2. Characteristic:  
— localized, discrete, diffuse
3. Remaining Coronary Arteries:  
— normal, minimal, significant disease
4. Myocardium:  
— normal, scar-diffuse, discrete  
— aneurysm-acute, chronic
5. Mechanical lesions:  
— mitral regurgitation, septal perforation.

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TABLE II  
CLINICAL INDICATIONS FOR CORONARY  
BYPASS SURGERY

**With Favourable Anatomy**

1. Firm severe disabling angina pectoris.
2. Unstable angina pectoris with recurrent myocardial ischemia.
3. Impending myocardial infarction with preinfarction angina.

**Less compelling**

4. Lesser degrees of angina pectoris, with or without heart failure.
  5. Significant anatomic lesions in the absence of symptoms during stress.
  6. In early myocardial infarctions.
  7. Intractible cardiac arrhythmias.
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sion can be made about coronary bypass surgery, these factors must be considered in detail and decisions reached on the basis of the presence of truly critical proximal lesions with adequate distal vessels to accept and maintain blood flow by way of the grafted implant. Previous myocardial infarction is not in itself an absolute contraindication to revascularization, particularly, if the patient continues to experience serious angina pectoris brought on by factors which might be considered to increase the demand for coronary blood flow. However, the presence of previous chronic congestive heart failure without significant angina and with a clearly enlarged heart is in our opinion a contraindication to revascularization. Such hearts may have significant discrete or diffuse scarring, or to be characterized by a generalized myopathic state—coronary cardiomyopathy. Coronary revascularization is not successful in restoring function to the myocardium under this circumstance. It has been suggested that segmental resection of part of this myocardium may be helpful. In our small experience this has not always proven to be the case and we are now reluctant to accept patients with an end-diastolic left ventricular volume in excess of 140 ml/M<sup>2</sup>. [Normal 80-120 ml/M<sup>2</sup>], the absence of significant angina pectoris.

The conventional clinical indications for myocardial revascularization are listed in Table II. Of these by

far the commonest is angina pectoris, non-responsive to an adequate trial of medical therapy. This therapy includes the management of hypertension and transient arrhythmias, reduction in body weight if the patient is obese, the use of Inderal, Isordil, and Nitroglycerin, and consideration of an appropriate exercise or conditioning program. In some patients, and particularly in the younger, progression of the symptoms may be too rapid and surgical treatment is promptly indicated. In the older patient with non-progressive angina pectoris, a part of the decision can be made by the patient himself if he decides that his life style under current limitations is grossly unsatisfactory to him. From this standpoint the objective of the operation is to relieve his severe chest pain and improve the quality of his life so that however many years are available to him will be sent in as satisfying manner as possible.

Unstable angina pectoris should always be considered as an indication for early study and for possible emergency surgical therapy. This is particularly true in the younger individual with a subtotal occlusion in a critical location who is certainly at an increase risk for sudden death or massive myocardial infarction<sup>8</sup>.

The above indications are in many ways relative. The patient who at an early age develops a severe symptom suggestive of high grade proximal obstructive disease is clearly deserving of study and consideration for surgical therapy. On the other hand, the older patient with chronic stable angina pectoris which is not so severe to grossly limit the quality of the patient's life is less at risk, is likely to have more diffused distal disease, is unlikely to be in a category in which significant prolongation of the duration of life is possible, and who will do reasonably well on medical management.

While there are no absolute contraindications to performance of the operation, in our opinion the presence of serious additional disease including clinical diabetes, severe atherosclerosis, and other vascular systems, hypertension, and chronic pulmonary disease renders a candidate a less favorable choice.

In summary, myocardial revascularization by means of aortocoronary artery vein bypass grafting is a suitable form of therapy in certain of the subjects of coronary heart disease. Surgical skills are all important and have thus far been disregarded as an important variable in outcome. The most favorable candidate for operation has critical proximal obstructive lesions in one or more of the coronary arteries sufficient in severity to produce myocardial ischemia either at rest or during stressful situations. If such a patient has adequate distal vessels his symptoms may be totally relieved and in all probability his individual expected duration of life enhanced. On the other hand, chronic congestive heart failure due to coronary disease with severe cardiomegaly appears to be unlikely to respond favorably to this operative procedure. Clearly, however, revascularization is of much less benefit when myocardial damage has been completed as after a massive myocardial infarction, than when ischemic but viable myocardium is amenable to revascularization.

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