

VENOUS BYPASS SURGERY

By W. Dudley Johnson

Vein bypass surgery for coronary insufficiency has developed unprecedented enthusiasm during the past five years. This enthusiasm, particularly among surgeons, has been sharply criticized by a number of medical people. A major area of criticism has been the gross lack of a controlled series comparing the surgical results with the results of conventional medical therapy. Surgical mortality is often compared with medical mortality, and surgeons have been criticized because the operative mortality often accounts for one or two years of so-called medical mortality. On the other hand, there are no adequate studies in which comparable groups of medical and surgical patients can be compared. How can one compare a series of patients with documented extensive disease with another series, many of whom have had a diagnosis made on clinical impression or on electrical events, which may or may not relate to ischemia. The major purpose is not to compare medical versus surgical therapy. The latter has changed so fast during the past five years, that unless a major breakthrough in medical treatment occurs, it is unlikely that comparable groups will ever be found. What are some of the things that have caused this continued surge of enthusiasm during the past five years? First, surgical techniques have advanced to the point that virtually any distal coronary artery with a lumen diameter of 1.5 millimeters, or greater can be used for a direct bypass. This means that over 99 percent of coronary patients could potentially benefit from bypass surgery. Patency rates appear to be quite satisfactory (Table I). Initial patency consistently exceeds 90 percent. There appears to be an additional failure of about ten percent of the grafts during the first year. This late failure appears to be due to either thrombosis or subintimal fibrous occlusion of the vein graft. This is not a continuing

process, however, and late failure after 18 months has not yet been documented. One of the significant factors which appears to relate to patency is the amount of flow which goes through the vein graft as recorded at the time of surgery. In my own series the patency relates to flow only with flow rates of less than 20 ccs. per minute. Once the flow exceeds this level the patency rate consistently has been satisfactory. With this knowledge in mind, bypass grafts are now rarely inserted into the very small distal arteries where the flow rate is likely to be less than 20 ccs. per minute. Because there has been a small but definite percentage of late failure with the vein graft techniques, continuing efforts have been made to improve the bypass procedure. Most significant among these has been the development of the direct mammary artery to coronary bypass technique. One or both mammary arteries are now commonly used, and have been connected to any of the three major coronary vessels. While not as versatile as the vein graft, the mammary-coronary procedure appears to be the procedure of choice when it can be used. With over 150 mammary-coronary procedures performed during the past two years, there has not yet been a single patient with recurrent symptoms or infarction due to late failure of the mammary-coronary bypass. While the flow rates achieved with this technique are not as high as with the vein graft, the patients clinically do equally well and the exercise studies are equally as good as in patients with vein grafts. Because the late failure rate is clearly less than with the vein grafts, the mammary-coronary procedure should be used whenever possible.

Coronary surgery has often been considered only in terms of relief of angina. Relief of angina it does do, and with a considerable degree of success. Among 886 patients returning a questionnaire (91 percent of total group), 66 percent were totally relieved of pain and another 25 percent were markedly improved. The minimum follow-up was six months and the maximum 40 months. As revascularization has become more complete, and with the use of the mammary bypass, this nine percent failure rate appears to be declining.

Effective revascularization does far more than relieve angina. Bicycle ergometry studies before and after surgery show marked improvement in function especially in response to stress. In patients with relatively good resting ventricular function, there are highly statistically significant changes after surgery. Revascularization is relatively ineffective in improving function in patients with large badly damaged hearts. When performed before extensive damage has occurred, improvement in function is equally as dramatic as is the relief of angina.

Enthusiasm for this surgery is also based on the long-term follow-up studies. The overall late mortality rate is running one and one-half to two percent per year. This mortality rate is considerably less than the mortality rate in most medical series. In 1971 the preoperative mortality rate at our Center was running three percent per month. This extremely high preoperative mortality rate also tends to suggest that the average patient referred to the surgeon is not comparable to the usual patient in a medical series. Even more impressive is the fact that in patients with good functioning ventricles the late mortality rate is running less than one-half of one percent per year. Most of the surgical and late mortality occurs in patients with moderate to severely abnormal ventricular function (Table II).

TABLE I
PATENCY RELATED TO FLOW
0 - 3 MONTHS

Flow ml/minute	Total No. of Veins	Total No. Closed	Total No. Patent	% Patent
20	20	8	12	60.0
21 - 40	60	2	58	96.7
41 - 100	106	9	97	91.5
101	17	1	16	94.1
4-12 months				
20	3	1	2	66.7
21 - 40	19	4	15	78.9
41 - 100	48	11	37	77.1
101	13	2	11	84.6
13 or more months				
20	6	4	2	33.3
21 - 40	18	2	16	88.9
41 - 100	44	7	37	84.1
101	13	1	12	92.3

Vein graft patency has been correlated with vein graft flow and with time. If flow is over 20 ccs. per minute, the early patency rate in the authors experience has been quite favourable. Patients are not ordinarily studied in the 4-12 month interval, and this group is largely selected patients who have not done well clinically. Most vein failures occur within one year, and this failure rate is now estimated at 8 to 10%. Failure after 18 months has not yet been documented.

TABLE II
SUMMARY OF SURVIVAL IN VEIN GRAFT
SURGERY

March, 1968 - June, 1971

LV Angio	Patients	Operative Survival Percentage	Number of Deaths	Late Survival Percentage 6 - 36 Mths.	Number of Deaths
Normal Mild General Hypokinesis	360	95	19	94	4
Localized Hypokinesis Single Wall	171	91	15	91	1
Localized Hypokinesis Double Walls	109	86	15	80	7
Severe General Hypokinesis	66	79	14	70	6
Aneurysm Resection (with vein graft)	85	75	21	65	9
	791	89		86	

Surgical and late mortality relate closely to the degree of ventricular malfunction. While the surgical mortality is declining yearly in each group, this table represents the composite results. There has been a three percent late death rate with over 18 month follow-ups, and most of this is in patients with poor ventricular function. Surgical and late death statistics indicate that the best results with surgery occur when it is done before extensive infarctions have occurred.

One of the major difficulties in selecting the surgical patient is the lack of knowledge of the natural course of the disease. Efforts to learn about the natural course of the disease have been made. One-hundred and twelve patients have been followed who were catheterized and advised to have surgery by the cardiologists but for variable reasons failed to come to surgery. The average follow-up in this group of patients was 23 months. One-half of the 112 patients are dead.

This extremely high mortality in the non-operated patients also suggests that the patient referred to the surgeon is not comparable to the usual medically followed patients. In evaluating various factors related to the mortality in this group of patients, one factor holds predominant importance. This factor is the cor-

onary anatomy, and in particular, the lethal factor is a major stenosis in the coronary artery high in the anterior or descending or in the left main coronary. Amongst the dead patients, a major stenosis high in the left coronary system was identified in 55 percent. In the 56 patients who are still living the left coronary stenosis was present in only 18 percent of the patients. This difference is statistically significant with a p value of less than .01. This information has led us to recommend surgery at an early date for any patient with a major stenosis high in the left coronary system, with or without significant anginal symptoms. It is apparent from all of the coronary mortality studies that angina alone is inadequate to evaluate patients. Less than one-half of male patients ever develop significant angina during the course of their coronary disease. The patients are referred for surgery only when intractable angina occurs, the majority of patients will not benefit from this technique. As improved knowledge of the natural course of the disease is developed, undoubtedly the selection of patients for surgery will improve. At the other end of the spectrum, new efforts need to be directed toward identifying patients who have ischemic but viable myocardium which is not functioning normally. This type of myocardium often improves dramatically following revascularization. At the present time the ability to differentiate ischemic viable myocardium from fibrotic and scarred tissue is grossly inadequate.

Venous bypass surgery for coronary disease has developed great enthusiasm because it can markedly alter the incapacitating symptoms of angina in over 90 percent of the patients. While this change is immediate and dramatic in many instances, the affects of this surgery on long-term mortality are not yet documented although very encouraging results appear to be forthcoming. Improvement in ventricular performance occurs in a large percentage of patients as demonstrated by various types of exercise testing. While angina can be relieved with a great deal of predictability, the improvement in ventricular performance improves with much less predictability because of our gross inability to differentiate ischemic but viable muscle from fibrosis and scar tissue. Until some major breakthrough occurs in the medical treatment of atherosclerosis, surgery would appear to offer a very significant role in the treatment of a large percentage of coronary patients. The improvement in the quality of life considerably exceeds that which can be achieved with any conventional form of medical treatment. Furthermore, the decrease in mortality rate following surgery is encouraging, and if it continues should significantly decrease mortality from coronary disease.