Coronary bypass for acute rest angina 10 year follow-up

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SUMMARY We followed up for 6.5 to 10.3 years 100 consecutive patients who had had coronary bypasses (1.8 per person) for acute angina at rest. There was a mean of 2.1 coronary stenoses per person. Mortality rates were 1.4% per postoperative year, or 2.2 times that of normal subjects of the same age. Angina was usually satisfactorily relieved but severe recurrences, mainly from late graft closure, required reoperation in 20 patients. Life style has been preserved; and 91 resumed work, with 52 at an average age of 61 years continuing to work eight years later. Better results than these may be obtained from the improved diagnostic and therapeutic methods of the 1980's.

Early reports of bypass surgery for acute coronary insufficiency indicated that a pronounced relief of angina could be obtained at a mean cost of 8% hospital mortality.¹⁻⁶ The subsequent course up to 10 years after such operations has been described in a single report. The survivors had a relatively low mean yearly mortality of 3%, the prevalence of angina rose from 19% at one year after operation to 53% at five years, and those patients with better treadmill tolerance had significantly fewer acute coronary events.⁷

Our first 100 patients undergoing urgent bypass had a total operative mortality of 0.8%, comparable to that of many centres today. We present their follow-up course to 10 years. We found that 89% of patients were alive and 84% of them had class I or II effort tolerance a mean of 7.8 years after operation; this supports the growing view that revascularisation of unstable anginal states can have enduring benefits at acceptable costs. The palliative nature of the procedure was shown by the fact that 20 patients required a second operation an average of 3 years after the first.

Subjects and methods

Patient selection, treatment, and five year postoperative course have been previously described.⁸ In summary, 125 consecutive patients admitted to hospital between June 1970 and March 1974 for typical severe acute rest angina which had begun to occur spontaneously within the previous month were subjected to early coronary arteriography by the Judkins techni-

que. Patients over the age of 70 years, those with signs of transmural infarction within one month or congestive failure, and those with other severe complicating disease, such as malignancy were excluded. Of the 125 patients, 10 had no critical coronary lesion and 15 had diffuse coronary and/or ventricular disease, so they were judged not to be surgical candidates. The remaining 100 surgical cases each had a mean of 2.1 stenoses greater than 70% of the luminal diameter in major arteries. An abnormality of left ventricular contraction was seen on angiography in 79 cases. None died or infarcted while awaiting coronary arteriography, but one had a nontransmural infarction during the procedure. In no case was beta blockade or balloon assist pumping used before operation.

Bypass operations (mean 1.8 grafts per patient) were performed, usually within 24 hours after arteriography, by senior surgeons using standard techniques in 99 patients. One patient with anterior descending coronary disease was explored but could not be bypassed.

All patients have been followed biennially until the autumn of 1980. Most were examined, but some were only contacted by telephone. Supplementary information was obtained from personal physicians and from hospital records.

Results

A worth-while surgical result with substantial or complete relief of angina was judged to have been obtained in 97 of the 100 patients. Of the remaining three patients, one had a large myocardial infarction

during the night between angiography and surgery, and never recovered from the ensuing low output state, dying three months later. A second patient had an exploratory thoracotomy only. The third case was found to have severe left coronary spasm without a fixed stenosis, resulting in graft closure with recurrent rest angina; this was the only recognised case of symptomatic vasospasm in the study.

Of the 100 patients, 89 were alive at the end of the follow-up period. Their clinical status is summarised in the Table. Seventy-five were leading active lives, having NYHA class I or II effort tolerance. Ninety-one had returned to work, and 52 were still working at the last follow-up; 18 of those who had stopped working had retired after their 65th birthday, and only nine of the total of 89 patients were disabled by heart disease. Thirty-five had had no further angina or effort intolerance since operation.

The incidence of angina postoperatively was 33% at 2 years, 37% at 5 years, and 52% at 7.8 years. This symptom reached class III or IV severity at various intervals after operation in 35 patients. Failure of adequate response to nitrates and/or propranolol led to a second operation in 20 cases with one death resulting from bleeding of uncertain cause. Of the 19 survivors, 14 experienced an improvement in angina to class I or II. Two patients who had a third bypass procedure survived.

Coronary arteriographic findings in the 20 patients who underwent a second operation included graft closure alone in eight cases, progression of native arterial disease in two; and both in 10. The principal type of graft replaced was saphenous vein in 14 (of the total of 130 inserted initially), internal mammary artery in one of 34, and radial artery in three of 16. An average of 1.7 grafts was inserted at the second operation. The interval between the first and the second operations was less than one year in five patients and greater than five years in seven, and averaged three years.

Episodes of late acute coronary insufficiency with or without myocardial infarction or congestive failure

were observed in 30 patients, a rate of 3.6% per postoperative year.

Eleven of the 100 patients died at intervals from 0.3 to 7.5 years postoperatively, averaging 3.7 years. Their ages averaged 63 years at death. Heart disease accounted for deaths in seven cases, cancer in three, and one died accidentally. The survival curve by life table method, compared with an age and sex adjusted normal series, is presented in the Fig.⁹

Discussion

The principal accomplishments of revascularisation in these 100 patients appear to have been three: pronounced relief of angina in 97; improvement in effort tolerance by 2 or 3 NYHA classifications in 87; and a possible prolongation of life in the group as a whole, with 89 patients being alive an average of 7.8 years after operation.

The postoperative improvement in 97 of 100 patients was attended by return to work in 91, 52 of whom were working an average of 7.8 years later. Apart from the personal satisfaction of resuming an active life, the economic benefit from the operation may be illustrated by the fact that the total earnings of this group after operation was approximately eight times the cost of their professional and hospital care, a figure unlikely to have been achieved without operation, as half of the group would probably have continued to suffer class III or IV angina.

A contrasting experience reported by Russell *et al.*¹⁰ showed a lower rate of return to work in patients with unstable angina, with 54% of those randomised to medical treatment and 44% of those to bypass surgery employed approximately 12 months later. The crossover of one-third of the medical group to surgery did not increase their employment rate. Proudfit *et al.* noted that 37% of men with medically treated coronary disease were still working 10 years after arteriographic diagnosis.¹¹

To what factors may one attribute the generally favourable course of the present cases? First, patients with severe ventricular disease, including acute transmural infarction or congestive failure or diffuse coronary lesions, were with two exceptions not offered surgery. Second, the bypass operations were done only by experienced surgeons who achieved the unusually low mortality rate of 0.8% at a time when reported rates averaged more than 5%. This low figure implies expert myocardial preservation and graft construction, such as those widely achieved at the present time. Third, the operation consisted of a single bypass graft in 35 patients, though 12 of them had 50 to 65% stenosis of a second major artery that nowadays would be grafted and which should have had an adverse effect. Fourth, considerable attention

Table Clinical status of 89 patients eight years after urgent coronary bypass

Age: 42-78 years	Average: 61.1 years
Male sex	75 patients
Angina free	43 patients
NYHA Class I	52 patients
NYHA Class II	23 patients
NYHA Class III	14 patients
NYHA Class IV	0 patients
Working	52 patients
Disabled by heart disease	9 patients
Retired $\geq$ age 65 years	18 patients
Reoperated	18 patients

Fig. Life table survival of 100 patients having bypasses compared with general population of same age (54 years).

was paid to postoperative care with follow-up care by the cardiologist and surgeon as well as by the personal physician.

Our management procedure for patients with unstable angina was developed in 1970 and differs in some respects from the current widely accepted one.¹²⁻¹⁴ The latter advocates giving nitrates, beta blockers, and/or a calcium inhibitory drug for various periods. Coronary arteriography is deferred for some days in those who quickly become symptom free and often for a longer period when stress electrocardiography shows a good exercise tolerance or when patients seem physically or emotionally unsuited for surgery. Arteriography is done usually on day 3 or 4 in those patients who have severe recurrent pain after optimal medical management has been achieved over a 24 to 48 hour period, as these high risk cases have a poorer prognosis¹⁵ and a higher incidence of significant coronary stenosis.¹² The demonstration of critical left main, double, or triple coronary disease leads to bypass surgery within a day or two in the high risk cases and to a conveniently scheduled operation in the others. Thus, three to five days elapse between admission to hospital and operation in high risk individuals and four days to a week or more in patients who respond to medical treatment. While this deliberate management plan has the advantages of more thorough patient evaluation and care and of convenient scheduling of procedures, it has three principal shortcomings: (1) It is associated with a death rate in hospital of about 3% and a myocardial infarction rate of 5 to 9% in the medically treated groups, including those in whom surgery is planned; (2) recurrent angina in one-third of cases treated medically after early pain relief results in operation being necessary later after increased aggregate suffering and expense; (3) effort intolerance and severity of residual angina are greater at least during the first two years of follow-up in most patients treated by medical means alone.

We suggest a modified management plan in the light of the present report to attempt to counter these drawbacks. The first 12 to 24 hours in hospital con-

sist of intensive medical treatment with repeated clinical assessment, including electrocardiograms during pain. Patients who then appear free of serious complicating disease and who are favourably disposed towards having surgery are offered coronary arteriography whether or not the pain has subsided, as its pathological cause remains and may progress. The two-thirds of this group who are found to have one or more large segments of ventricle with jeopardised function, and greater than 70% fixed stenosis of two or more large coronary arteries, undergo bypass grafting usually by the third day in hospital. This advice assumes that the risk of surgical mortality is under 2%, a figure now widely achieved. The management of the patient with a single vessel stenosis or with severe ventricular damage and/or distal vessel disease remains unsettled, and judgment in the individual case may await demonstration of refractoriness of the angina to medical treatment. This regimen is designed to effect optimal relief of the severe acute coronary insufficiency that can be confirmed arteriographically in approximately 90% of patients with severe unstable angina; it is not merely an attempt to qualify them for surgical treatment. It avoids operating on this type of patient as an emergency within 24 hours of admission, a practice that has been shown to increase the risk of death to 4%, and in particular of perioperative myocardial infarction to 17%, by one experienced group during the 1970-76 period.¹⁶ Newer methods of treatment such as percutaneous transluminal coronary angioplasty¹⁷ or the infusion of lytic agents¹⁸ in the unusual case of fresh coronary thrombosis¹⁹ may be useful in some patients.

The palliative nature of the bypass operation is exemplified by the progressive return of angina post-operatively in most cases, both in Davidson's⁷ and in 65% of our series. The apparent basis for this symptomatic deterioration is narrowing of the graft(s) and to a lesser degree of the native coronary arteries, processes that at present appear to be not particularly amenable to treatment.²⁰ The recurrence rate of such stenoses in our patients can only be estimated, since repeat coronary arteriography was done only in those

who had severe symptoms. In the latter, this nearly always showed a critically ischaemic area, which in 19 of the 20 patients was successfully revascularised with renewed relief of angina in 14. When repeat coronary arteriography was done routinely in 100 coronary patients bypassed in the early 1970's, Campeau *et al.* found a mean annual vein graft closure rate of 2.1% between the first and sixth year after operation.²¹

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