

Effect of bypass graft surgery on survival

A 6- to 10-year follow-up study of 741 patients

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Among the surgical approaches to myocardial revascularization which have evolved in the past quarter century, none has evoked the sustained interest nor stimulated the detailed studies of efficacy as has the bypass graft technique. That this procedure has a salutary effect upon symptoms has been generally confirmed by a number of centers. Assessment of its effect upon survival has been complicated by difficulties in designing effective, controlled randomized studies. Nevertheless, a long-term follow-up of a large surgical series may be of interest to determine if, in addition to relieving the symptoms of myocardial ischemia, surgical treatment has any apparent effect upon survival.

Long-term follow-up studies were undertaken in a group of 741 patients treated with bypass grafts at the Cleveland Clinic from May 9, 1967, through December 31, 1970. Patients with significant associated congenital or rheumatic heart disease or who had previous heart surgery, and those who had associated procedures in conjunction with their bypass graft operation were excluded. Without previously established guidelines, the selection of patients for bypass graft surgery was based upon severity of symptoms, anatomical severity of the coro-

nary artery lesion, the number of involved vessels, and the apparent integrity of the myocardium in the region perfused by the arteries to be grafted. Certain hypotheses influenced case selection in this early series: that operations upon patients with severe preoperative myocardial damage or those requiring more complex procedures would be associated with greater operative morbidity and mortality as well as less favorable long-term results. A 100% follow-up has been achieved from 6 to 10 years after surgery.

Single-vessel involvement ($>70\%$ stenosis) was present in 414 patients (199 RCA, 187 LAD, 28 LCx). Two vessels were involved in 195 patients, three vessels in 69, and the left main coronary artery (with or without additional lesions) was involved in 63 patients. The total number of interposed or bypass vein grafts was 1122, an average of 1.5 grafts per patient. The surgical revascularization attempt was considered complete in 588 patients and incomplete in 153 patients.

The incidence of transmural perioperative myocardial infarction was 6.9%. The hospital mortality for the entire group was 3% (1.7% for single-vessel involvement, 3.1% for double,

4.3% for triple, and 9.5% for left main coronary involvement).

All patients were followed for at least 6 years. For actuarial purposes, any patient who underwent a second cardiac operation was retained in the series only until the time of the reoperation. There were no dropouts for any other reasons. A total of 80 patients died after they were discharged from the hospital, 51 of cardiac causes. Twenty-six deaths were from noncardiac causes, and the cause of death was unknown in three patients. The actuarial survival data for the various groups in this surgical series are summarized in *Table 1*.

Inspection of survival curves demonstrates only slight differences in the survival of subgroups of patients with single, double, triple, or left main coronary artery involvement, in contrast with the divergent survival curves usually observed for medically treated groups with varying extents of involvement. This suggests that surgical treatment may influence survival in certain groups of patients.

Assessment of the effect of surgery upon survival requires a basis for comparison. Since criteria for surgical selection were based largely upon angiographic findings, any nonsurgical comparison group requires selec-

Table 1. Percent survival after bypass graft surgery*

	No. patients	Postoperative interval (years)						
		1	2	3	4	5	6	7
Single	414	97.3	95.5	94.4	92.8	91.5	91.1	90.7
Double	195	94.8	92.7	92.1	89.4	87.8	85.4	+
Triple	69	94.0	91.0	91.0	86.4	84.8	80.3	+
Left Main	63	88.7	88.7	87.1	87.1	85.5	85.5	+
Total	741	95.6	93.8	92.9	90.8	89.4	88.1	87.6

* Hospital mortality, cardiac and noncardiac deaths included.

+ < 50 patients at risk.

tion by similar criteria. Among the limited number of follow-up studies available for patients with angiographically documented coronary artery disease, only the study of Proudfit et al includes a sizeable group of surgical candidates, as determined by angiographic criteria, who have been followed for 6 or more years. Although comparison of the surgical group with this medical series is imperfect since they are neither randomized nor contemporary, a better comparison group is not yet available. An element of preselection is common to both groups since most patients are referred for coronary arteriography because of symptoms. The clinical and angiographic characteristics of the two groups are similar, medical treatment was similar although not strictly controlled, and 100% follow-up was achieved in both groups.

When compared to Proudfit's medically treated surgical candidates with single-vessel involvement, there is no apparent difference in the survival of surgically treated patients with single-vessel involvement. When medical and surgical groups of patients with double, triple, or left main

coronary artery involvement are compared, substantial differences in survival are apparent, favoring the surgical groups (*Table 2*).

Other studies have also demonstrated the favorable effect of bypass graft surgery upon survival in patients with left main coronary artery involvement. These surgical groups with double- and triple-vessel involvement demonstrated mortalities of 14.6% and 19.7% respectively after 6 years. We are unaware of a more favorable survival experience in similar groups of medically treated patients with severe disease.

Bypass graft surgery can be accomplished in selected patients with coronary atherosclerosis with low morbidity and mortality. Symptomatic improvement occurs in most patients and can be correlated with completeness of revascularization. These follow-up studies demonstrate that bypass graft surgery does not have a deleterious effect on the clinical course of coronary artery disease in sizeable, carefully selected patient groups, but improved longevity is suggested, particularly in those with more extensive involvement.

Table 2. Percent survival of medically treated surgical candidates*

	No. patients	Postoperative interval (years)					
		1	2	3	4	5	6
Single	111	98.2	97.3	96.4	94.6	88.3	81.7
Double	149	91.9	83.2	76.5	72.5	68.5	67.8
Triple	92	88.0	77.2	68.5	59.8	56.2	45.6
Left Main	36	80.6	69.4	63.9	61.1	55.6	52.8
Total	388	91.8	84.5	79.1	74.4	70.1	65.1

* Proudfit et al.