# Survival following bypass graft surgery

Edwin L. Alderman, M.D.
Christopher R. Brown, M.D.
Gary R. Sanders, M.D.
Edward B. Stinson, M.D.

*Stanford, California*

The initial 400 patients having coronary bypass graft surgery at Stanford University Medical Center have been followed at annual intervals since the time of their surgery between 1969 and 1971. After excluding those with concomitant aneurysmectomy or valve replacement, 341 consecutive patients have had sequential follow-up, 86% of whom are men and 63% of whom had prior myocardial infarction. Operative mortality in these 341 patients was 4.9%. A more recent series of 533 patients operated on between 1972 and 1973 yielded an overall operative mortality rate of 2.1%. Operative mortality was higher in women (4.3% versus 1.7%), higher in patients over age 65 (10.4% versus 2.3%), and higher in patients with left ventriculographic abnormality (3.1% versus 1.6%).

Left ventricular dysfunction not only increased operative risk but had a marked effect on long-term survival. Patients with moderate to severe left ventricular dysfunction had a 60% 5-year survival versus a 92% survival in patients with normal or mild left ventricular dysfunction. In sequential annual follow-up, the percentage of patients with congestive heart failure symptoms of Class III or IV severity remained between 8% and 12%/yr reflecting the fact that

the major attrition of patients occurred from the subgroup with moderate to severe heart failure.

The date when surgery was performed affected not only operative mortality but also influenced long-term survival, as suggested by the data shown in *Figure 1*. These actuarial plots show a trend toward improved survival for those patients operated on in more recent years. The data are based on results of surgery in 170 patients prior to May 1971, 171 patients between May 1971 and February 1972, and 533 patients between February 1972 and August 1973. During 1971 and 1972, changes in surgical technique included the use of continuous suture technique for the distal anastomosis, use of topical cooling and induced fibrillation, and use of vasodilators postoperatively. Although changing patient selection factors could account for this trend, this did not seem to be the case, and the trend toward improved longevity with more recent operative dates suggests that the surgical bypass procedure can beneficially affect survival.

*Figure 2* shows a comparison of single-vessel grafting versus multivessel grafting in the initial 341 patients operated on at Stanford. Although between 1969 and 1971 not all lesions were bypassed, the number of grafts closely reflects the extent of coronary disease. The fact that patients with multivessel grafting have a survival curve which is not statistically different from the survival curve of single-graft patients is distinctly different from previously reported natural history studies. These results suggest that for multivessel disease patients, coronary bypass graft surgery may exert a beneficial effect on longevity.

*Figure 3* shows the result of sequential analysis of anginal symptoms as reported and interpreted primarily by patients' physicians. A grading system of 0 to 4 was used with 0 defined as no angina: 1—defined as rare or infrequent episodes, 2—defined as mild angina precipitated by strenuous activity, 3—defined as angina precipitated by ordinary activities, and 4—defined as angina at rest. Although surgery clearly benefitted anginal symptoms, there was a gradual, progressive, increase in the proportion of patients exhibiting anginal symptoms during annual follow-up. Our recent studies suggest that this redevelopment of angina primarily is

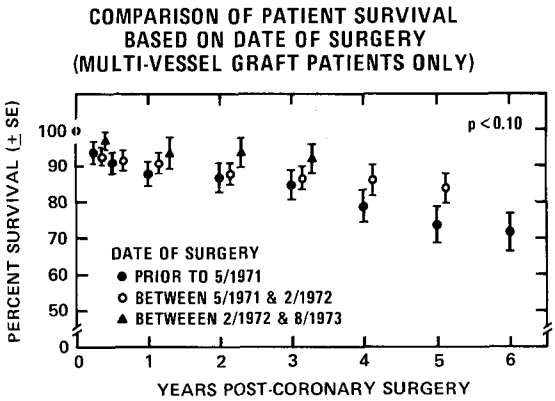


**Fig. 1.** Survival based on date of surgery.

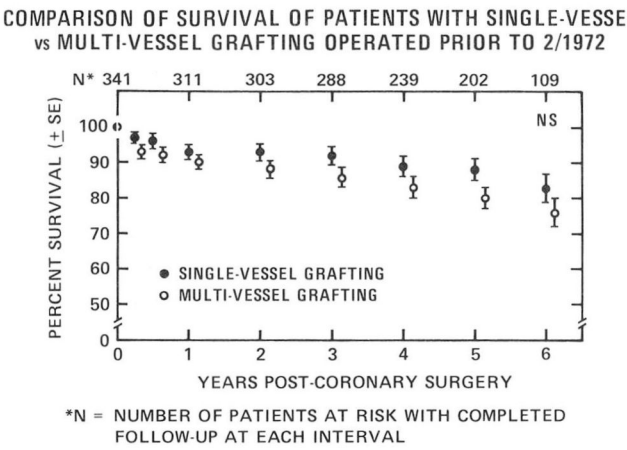


**Fig. 2.** Survival of patients with single-vessel grafting vs multivessel grafting.

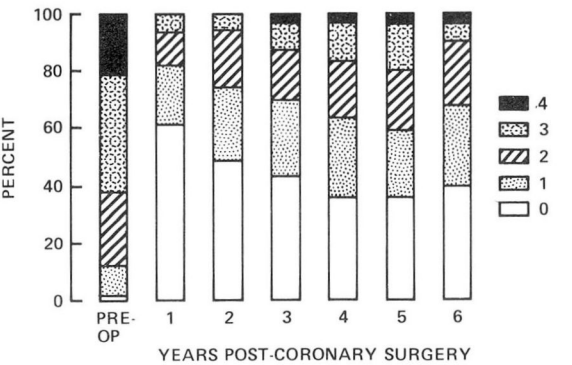


**Fig. 3.** Result of sequential analysis of anginal symptoms.

due to progression of coronary disease rather than graft occlusion.

We conclude from our studies that (1) progressive improvement in operative mortality and survival curves has resulted from improvements in surgical and postoperative care; (2) left ventricular function is a primary determinant not only of immediate operative mortality, but also of long-term survival; (3) multivessel coronary disease, when treated surgically, has a prognosis similar to that of single-vessel disease (4) the extent of relief of angina tends to diminish gradually following coronary surgery, but most patients still retain some symptomatic benefit from their preoperative status.