Bypass Grafting for Preinfarction Angina

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"Preinfarction angina" is a degree of coronary insufficiency intermediate in severity between chronic angina pectoris on the one hand and actual myocardial infarction on the other. The syndrome has been described in some detail during the past 20 years, with considerable emphasis on early diagnosis and efficacy of different forms of therapy because of the high percentage of patients who subsequently develop a myocardial infarction. A variety of terms have been used for the condition, including "acute coronary insufficiency," "coronary failure," and "intermediate coronary syndrome." With the impressive prompt relief of angina in the majority of patients with bypass grafting, contrasted with the limited benefits thus far with bypass grafting for actual myocardial infarction, the role of emergency bypass grafting for patients with "preinfarction angina" is being carefully evaluated.

The importance of delineating the group of patients with a serious risk of impending infarction is further indicated by the fact that a high percentage of patients with myocardial infarction give a history of symptoms of preinfarction angina for some time before the infarction occurs. Wood stated that, in a consecutive series of 100 cases of myocardial infarction, preinfarction angina was present for an average period of 3 weeks in 45% of the group. Vakil similarly reported that in a series of 1804 cases of myocardial infarction observed over a period of time, the instance of premonitory chest pain was 39%. It is theoretically possible that emergency bypass grafting during the preinfarction phase would have prevented myocardial infarction in many of these patients.

Physiologically, the condition is apparently a degree of myocardial ischemia sufficient to produce angina at rest, but initially not severe enough to produce the myocardial necrosis of a classic myocardial infarction. The onset is sudden in many cases—81% of 150 cases reported by Paul Wood, seen over a period of 10 years—suggesting that an acute coronary occlusion has occurred but muscle necrosis has not yet resulted.

The pathologic lesions in typical angina pectoris and preinfarction angina are similar. At least 90% of patients with classic angina pectoris will be found on coronary arteriography to have significant obstruction of one or more major coronary arteries, either complete occlusion or a stenotic lesion reducing the cross-sectional area more than 75%. In preinfarction angina, a similar pattern of atherosclerosis has been found. Proudfoot, Shirey, and Sones found that the distribution and severity of coronary artery lesions were similar in patients with preinfarction angina, stable angina, and angina with prior myocardial infarction. In a group of 57 patients operated upon under emergency circumstances by Lambert and associates, selected from a total experience of 300 patients undergoing aortocoronary bypass grafting, 48 of the operations were for impending infarction, and nine for either arrhythmias or arrhythmias combined with impending infarction. In this group, 16 patients had single-vessel disease, 15 double-vessel disease, and 26 triple-vessel disease.

A small percentage of patients, probably 10–15%, with acute chest pain resembling angina will be found to have normal coronary arteriograms. Usually this group has had no prior history of coronary disease. The correct diagnosis in these patients remains uncertain.

Clinical Features

The pain is a typical anginal pain, but often occurs spontaneously, unrelated to emotion or exercise, and continues for varying periods of
time, without significant response to either rest or nitrites. Usually there are no abnormal cardiac physical findings, but the electrocardiogram in 85–90% of patients will show T-wave and S-T-segment abnormalities of myocardial ischemia. None of the signs of myocardial necrosis, such as elevation of enzymes, fever, or leukocytosis, is present. As mentioned earlier, the onset is sudden in as many as 80% of patients. Somewhat varying with different patient populations, three different groups of patients have been recognized with the syndrome. A certain percentage have had no previous history whatever of coronary disease. In a second group, there is a classical history of chronic angina pectoris, with the syndrome representing a sudden change in characteristics of the preexisting angina. A third group has a history of a myocardial infarction in the past but has been asymptomatic for some time until the present episode occurred. In a group of 100 patients reported by Beamish in 1960, 45 had no previous cardiac symptoms, 30 had had typical angina for varying periods of time, and 25 had had a myocardial infarction in the past but had recently been free of symptoms.5

The clinical course has varied somewhat with different reports. Death from an arrhythmia has been consistently infrequent in all series—range of 2 to 3%.1 In 1964 Vakil reported observations in a group of 360 patients seen over a period of 14 years.2 In 146 of the 360 patients (41%), classic myocardial infarction developed within 3 months of onset of symptoms. A high frequency of infarction was also reported in untreated cases by Wood, describing experiences with 150 cases over a period of 10 years.1 In 50 patients treated conservatively without anticoagulants, infarction developed in 22% within 2 months, while infarction occurred in only 3% of 100 patients treated with anticoagulants. Wood emphasized that the illness was not necessarily acute, for the episode lasted less than 6 weeks in 50% of his 150 cases, but between 2 and 6 months in 45%, and for an even longer period in 5%.1 The ultimate prognosis was quite grave, for about one third of the initial survivors were dead within 5 years, another third had recurrent coronary episodes, and the final third remained relatively well. Harrison and Reeves similarly considered preinfarction angina of utmost gravity with ominous implications.6 They equate the condition with other grave medical emergencies such as diabetic coma, acute pulmonary edema, and cardiogenic shock.

Beamish reported experiences with 100 patients and found that 14 of 15 patients treated without anticoagulants developed an infarction, but in a group of 85 patients receiving anticoagulants only two developed infarcts.5 In the group of patients reported by Beamish, assembled over a period of 9 years, the average duration of symptoms before the diagnosis was made averaged between 7 and 16 days for most patients, indicating that the clinical picture had been present for a significant period of time before the diagnosis was made.

With the prompt admission of patients with acute chest pain to coronary care units in the past decade, patients are now being evaluated much sooner after onset of symptoms. A recent study by Krauss of 100 patients admitted to the coronary care unit at the Massachusetts General Hospital with the diagnosis of preinfarction angina, found a much more favorable prognosis.7 Actual myocardial infarction was excluded from the series by the absence of electrocardiographic changes and elevation of serum enzymes within 48 hours after admission. The majority of the patients had chronic angina, but had developed protracted pain of anginal type of at least 30-min duration within 24 hours before admission. Admission to the hospital was prompt, for the prodromal period in the majority of patients was less than 1 week in contrast to the 1–2-week interval reported by Beamish.5,7 In this group of 100 patients, there was only one hospital death, and myocardial infarction occurred in six others, all of whom survived.7 The one fatality and the six infarctions all developed in a group of 36 patients who continued to have pain for more than 12 hours after admission to the coronary care unit.
Only a few of the 100 patients had coronary arteriograms, but electrocardiographic signs of ischemic heart disease were present in the majority.

The contrast between the relatively benign course in the 100 patients reported by Krauss and those described by previous investigators emphasizes the need for careful continuing study of this important problem. It seems likely that the more serious prognosis is associated with patients who continue to have chest pain despite hospitalization and treatment with bed rest and usually anticoagulants.

**Therapeutic Considerations**

The usual treatment for preinfarction angina is immediate hospitalization, bed rest, and often anticoagulants. How often emergency coronary arteriography should be performed, in anticipation of immediate coronary bypass operation, is a serious question. Of prime importance in such decisions is the exclusion of actual infarction. This can usually be done from the electrocardiogram and the serum enzymes. Surgical procedures for myocardial infarction, discussed elsewhere in this symposium, remain hazardous and on an experimental basis. It is quite clear, however, that once infarction has occurred, bypass grafting alone is of dubious benefit.

In considering the surgical possibilities with preinfarction angina, certain established facts regarding bypass operations for chronic angina pectoris are pertinent. These can be briefly summarized as follows:

First, at least 80–90% of patients with angina have significant obstruction of one or more major coronary arteries. This has been uniformly found by virtually every investigator in the field.4, 8–10

Second, a bypass graft can be inserted in at least 90–95% of patients with an obstructed coronary artery. The criteria for operability vary among different centers. At New York University, operative magnification is routinely employed and grafts attached to vessels are as small as 1-mm inner diameter. In addition, patients are operated upon with simple angiographic demonstration of obstruction of a major coronary artery, not relying upon demonstration of a patent arterial segment beyond the area of occlusion. Some centers require demonstration of a patent distal segment before considering a patient "operable." At New York University exploration of such patients has repeatedly found a patent vessel distally, making the operability well above 95%. Similar findings have been reported by Johnson10 and by Morris.11

Third, the bypass operation after myocardial infarction has occurred is in a very different category. Operation is hazardous, of uncertain benefit, and must be considered experimental at present. Most groups have less than five patients surviving emergency operation after myocardial infarction has occurred. The most extensive experience with operations for patients with acute infarction has been by Austen and associates at the Massachusetts General Hospital. These data are presented elsewhere in this symposium.

Fourth, an emergency bypass for preinfarction angina is associated with little increased risk as compared to elective bypass operations, and symptoms subside almost immediately after operation. Hence, the clinical syndrome is promptly and effectively treated with bypass grafting.

The risk of bypass operations is primarily related to left ventricular function. At New York University over 400 bypass operations have been performed since the first procedure in February 1968; 200 of these have been done in 1971. In this recent group of 200 patients, operative risk in 60 NYHA class II was 2%, in 100 class III patients was 5%, and in 40 class IV patients was 30%. The overall operative mortality for the 200 patients was 9%. There has been no mortality in the few patients operated upon under emergency circumstances with preinfarction angina.

In the 57 patients operated upon by Lambert and associates, there were three deaths (5.3% mortality), complications developed in 12%, and 82% of patients were free of symptoms at the time of the report. Johnson has reported operating upon over 80 patients under similar emergency circumstances, with
results very similar to those obtained with several hundred patients operated upon under elective circumstances.\textsuperscript{10} Mundth, in a discussion of the report by Lambert,\textsuperscript{12} stated that in a group of 250 bypass operations about 20% were done under emergency circumstances for the preinfarction syndrome. Uniformly good results were obtained.

With the good early results with bypass grafting, the serious question naturally evolves as to what criteria should be used to classify patients with preinfarction angina as “true emergencies,” similar to acute appendicitis and perforated ulcer. Such an approach implies immediate hospitalization, coronary angiography within a few hours, often in the middle of the night, and possible transport of the patient from the angiographic laboratory to the operating room. This management places a great strain upon hospital facilities and undoubtedly has somewhat more hazard than a planned approach in elective circumstances. Furthermore, the studies of 100 patients urgently admitted to the coronary care unit by Krauss indicate that many will improve promptly with the immediate institution of bed rest and other therapeutic measures.\textsuperscript{7} Almost all complications in their series occurred in a group of 36 patients who continued to have angina more than 12 hours after admission. In this group of patients, immediate angiography would seem clearly indicated. From the angiographic pattern, the possibilities of immediate bypass grafting can be evaluated. A significant stenosis of a major coronary artery would indicate immediate operation, whereas multiple areas of occlusion in small coronary tributaries would be less favorable.

Prompt arteriography should be more readily undertaken in patients with a history of chronic angina, in whom there is little doubt about the presence of serious coronary disease, as opposed to those with no previous symptoms of coronary disease. As mentioned earlier, in a small percentage of the latter group, no major obstruction of coronary vessels is found on angiography.

Hopefully, future studies will evolve further guidelines to pinpoint patients with a high risk of impending myocardial infarction. With the data now available from several sources, such patients clearly merit immediate angiography and operation, preempting routine considerations with other hospitalized patients. However, the group should be carefully delineated. Otherwise, a very large burden will fall upon hospital staff, with a real detriment to other patients undergoing elective diagnostic and therapeutic procedures. The magnitude of the decision is clearly evident in the report by Wood.\textsuperscript{1} He stated that in a consecutive series of 1000 cases of ischemic heart disease seen over a period of 10 years, 10% of the group were seen because of symptoms of preinfarction angina. At present this 10% group would be potential candidates for immediate angiography and bypass grafting.

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This concludes the Symposium: Myocardial Infarction 1972 which began in January 1972 Circulation. Copies of the entire Symposium, published as AHA Monograph No. 36 (EM262H), may be obtained from the American Heart Association Distribution Department at $5.00.
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Circulation. 1972;45:1314-1318
doi: 10.1161/01.CIR.45.6.1314

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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