Ventricular aneurysm

An appraisal of diagnosis and surgical treatment

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Twenty-three consecutive patients undergoing operation for left ventricular aneurysm are described with analysis of clinical and laboratory data obtained before and after operation. The reliability of various diagnostic methods is discussed. Five patients died in the perioperative period. Seven further patients have died during follow-up, 5 of recurrent myocardial infarction. The indications for operation are outlined with discussion of the benefits and limitations of current surgical treatment. It is felt that ventricular aneurysmectomy is indicated in a carefully selected group of patients. Though effects of surgical treatment on longevity cannot be completely evaluated, the status of the remaining coronary circulation appears to have an important influence on long-term survival.

Though ventricular aneurysm was first described by John Hunter (1757), this condition has come to be clinically recognized as an important complication of myocardial infarction only in relatively recent times with the advent of improved methods of diagnosis. Modern cardiac surgical techniques have made curative treatment possible, and reports of large numbers of patients successfully treated by operation have appeared (Favaloro *et al.*, 1968; Cooley and Hallman, 1968; Petrovsky, 1966). Proper selection of patients for ventricular aneurysmectomy requires a detailed knowledge of the clinical course of patients with this condition and an understanding of the reliability of the various diagnostic methods applied to these patients. Surgical morbidity and mortality, and the results of long-term follow-up must be analysed. We have examined these features in 23 consecutive patients who underwent operations for ventricular aneurysm.

Patients and methods

The case records of 23 consecutive patients undergoing operation for ventricular aneurysm at the Hammersmith Hospital during the period

1961-1970, inclusive, were reviewed. The clinical histories, course, findings on physical examination, electrocardiographic tracings, and other ancillary data were analysed in detail. Haemodynamic and angiographic findings at cardiac catheterization and selective coronary arteriography were reviewed. Findings at the time of operation were recorded. Details of postoperative follow-up on all 23 patients up to the time of writing were analysed. These observations and their relation to the available published material form the basis of this report. Unless otherwise indicated, Edwards' (1961) definition of ventricular aneurysm as 'a protrusion of a localized portion of the external aspect of the left ventricle beyond the remainder of the cardiac surface, with simultaneous protrusion of the cavity as well' will be applicable throughout this report.

Results

Age and sex Table 1 shows the age and sex distribution of the entire group of 23 patients. The ages listed are those at the time of operation. The mean age of all patients was 51.5 years, with over half the patients in the age range 50-59. Only 2 patients were female, giving a male to female ratio of 10.5:1.

Aetiology All 23 patients had clinical and electrocardiographic evidence of coronary artery disease and myocardial infarction before operation. Coronary artery disease was

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between the angiographic appearance and findings at the time of operation. None of the patients undergoing left ventricular cineangiography had significant mitral regurgitation.

The left ventricular end-diastolic pressure was raised above 15 mmHg in 8 of 10 patients in whom it was measured. The cardiac index was 2.2 l./min/m² or less in 7 of 10 patients in whom this measurement was made. Pulmonary artery systolic pressure was 35 mmHg or greater in 9 of 12 patients. Left ventricular end-diastolic volume, as estimated by the single plane angiographic method of Greene *et al.* (1967), was measured in 3 patients and found to be much increased in all, with values of 360, 410, and 463 ml, respectively.

One patient was studied both preoperatively and postoperatively, and was found to have much improved postoperative left ventricular function as judged by appearance of the left ventricular cineangiogram and a fall in the left ventricular end-diastolic pressure from a preoperative value of 19 mmHg to 13 mmHg in the postoperative study.

Coronary artery anatomy Information concerning the state of the coronary circulation obtained from selective coronary arteriography in 11 patients, surgical inspection, or postmortem dissection was available on 15 patients and is summarized in Table 4. Of these 15 patients, 14 had severe narrowing or total occlusion of the left anterior descending coronary artery, with the one additional patient having near total obstruction of the left main coronary artery. Additional lesions were found in the left circumflex in 7 patients, the right coronary artery in 6 patients, and the left diagonal branch in one patient.

Surgical findings Of the 23 patients, 22 underwent ventricular aneurysmectomy with the aid of cardiopulmonary bypass. One patient had only plication of an akinetic apical area. At the time of operation, 21 of the 23 patients had ventricular pathology conforming to Edwards' definition of ventricular aneurysm mentioned previously. Two patients had akinetic fibrotic areas, one located at the apex, the other on the anterior wall, without distinct protrusion during systole. Table 5 summarizes the site of aneurysm as determined at operation. All 23 patients had involvement of the anterior wall or apex, with one patient having inferior wall involvement also. No patient had a localized inferior wall aneurysm. Many of the patients with anterior wall aneurysms had fibrosis extending into the

TABLE 3 Preoperative chest film findings

Findings	No. of patients
Normal	2
Left ventricular enlargement without definite bulge	8
Localized bulge suggesting aneurysm	13
Total	23
Pulmonary oedema or congestion	10

anterior portion of the interventricular septum.

Only 2 patients had additional procedures performed at the time of operation. One patient had a right internal mammary artery implantation and another patient a saphenous vein bypass graft to the left anterior descending coronary artery. Mural thrombus was present in 18 patients at the time of operation, and absent in the other 5.

Survival and follow-up data Table 6 summarizes the postoperative follow-up data on the 23 patients. Five patients died before final discharge from the hospital, yielding a hospital mortality rate of 21.7 per cent. The causes and times of death are listed in Table 7. No patient died during the immediate postoperative period.

Seven patients died during follow-up, with a mean survival time of 26 months. The causes of death were recurrent myocardial infarction in 5 patients, arrhythmia (probable) in 1 patient, and cerebral vascular accident in 1 patient. Of these 7 patients, however, 6 had been much improved after operation as judged by improved exercise tolerance, physical examination, and chest film. They had returned to normal physical activity, and 1 patient had survived for over 6 years before dying of recurrent myocardial infarction.

Eleven patients are alive at the present time

TABLE 4 Incidence of coronary artery lesions in 15 patients

Degree of occlusion	No. of patients with lesions in				
	Left anterior descending	Left main	Left circumflex	Right	Left diagonal
Total occlusion	11	0	0	0	1
Severe narrowing (> 90%)	3	1	0	0	0
Moderate narrowing (50-90%)	0	0	7	6	0

TABLE 5 Site of aneurysm at operation

Location	No. of patients
Anterior wall	12
Apex	4
Anterior wall and apex	6
Anterior wall, apex, and inferior wall	1
Total	23

with an average follow-up of 25 months. Of these, 10 patients show evidence of improvement after operation, as judged by physical examination, chest film, and improved exercise tolerance. One patient, though initially improved for several months, now is again dyspnoeic on mild exertion, with evidence of generalized ventricular dysfunction.

Of the 18 patients surviving operation, 2 suffered cerebral vascular accidents at the time of operation, probably secondary to embolism. One patient was moderately restricted by residual hemiparesis and the other by dysphasia.

Time interval from myocardial infarction to operation The mean interval between acute myocardial infarction and surgery was 13.4 months for all 23 patients. This time interval for the 5 patients who died before final hospital discharge was 6.0 months, but was 15.5 months for the remaining 18 patients.

Discussion

In recent years ventricular aneurysm secondary to occlusive coronary artery disease has become increasingly recognized as an important complication of myocardial infarction. The incidence of ventricular aneurysm after myocardial infarction differs conspicuously in various published series due to differences in patient selection and diagnostic criteria (Dubnow, Burchell, and Titus, 1965; Johnston,

TABLE 7 Causes of hospital deaths

Cause of death	No. of patients
Fresh myocardial infarction (2 days after operation)	1
Respiratory complications and infection (15 days after operation)	1
Preoperative cardiac arrest with irreversible central nervous system damage (26 days after operation)	1
Low cardiac output state with renal failure and infection (50 days after operation)	1
Irreversible ventricular fibrillation (65 days after operation)	1
Total	23

Lam, and Wright, 1969; Abrams *et al.*, 1963; Schlichter, Hellerstein, and Katz, 1954; Gorlin, Klein, and Sullivan, 1967; Appelbaum and Nicholson, 1935; Mourdjinis *et al.*, 1968). In the comprehensive review of Schlichter *et al.* (1954), the average incidence of ventricular aneurysm in relation to the number of cases of myocardial infarction at necropsy in 13 collected series was 15 per cent. Using the strict anatomical diagnostic criteria of Edwards (1961), Dubnow *et al.* (1965) found an incidence of only 3.5 per cent. Gorlin *et al.* (1967), using cineangiographic criteria consisting of either akinesis or dyskinesis of a portion of the left ventricular wall, found that 24 of 100 patients with coronary artery disease undergoing left ventricular cineangiography had evidence of left ventricular aneurysm. However, only 1 of these 24 patients had clinical evidence of severe congestive heart failure, while in the necropsy series of Dubnow *et al.* (1965), using stricter anatomical criteria, congestive heart failure was considered to be a direct or contributory cause of death in 75 per cent of patients. In a prospective study of 112 patients admitted to a coronary care unit with acute myocardial infarction, Mourdjinis *et al.* (1968), using clinical, electrocardiographic, and radiological evidence, found the incidence of development of ventricular aneurysm after infarction to be 14 per cent. However, only 3 of the 112 patients developed major aneurysms fulfilling Edwards' (1961) diagnostic criteria. Thus, while more than 20 per cent of patients with severe coronary artery disease may develop localized areas of ventricular dysfunction which fulfil radiological criteria for the diagnosis of ventricular aneurysm, a significantly smaller percentage develop major ventricular aneurysms with clinical and haemodynamic features warranting surgical consideration.

TABLE 6 Survival and follow-up data

	No. of patients
Hospital deaths (2, 15, 26, 50, and 65 days after operation)	5
Deaths during follow-up (3-76 months after operation; mean survival time = 26 months)	7
Living (7-66 months after operation; mean follow-up = 25 months)	11
Total	23

It is generally agreed that the mortality rate in patients with coronary artery disease is significantly increased in the presence of ventricular aneurysm. Five-year survival rates after first myocardial infarction in patients developing ventricular aneurysms are quoted at 12 per cent (Schlichter *et al.*, 1954) and 27 per cent (Dubnow *et al.*, 1965) in two large necropsy series. The high incidence of morbidity in patients with major ventricular aneurysms is also well documented (Favaloro *et al.*, 1968; Cooley and Hallman, 1968; Dubnow *et al.*, 1965; Johnston *et al.*, 1969; Schlichter *et al.*, 1954; Mourdjinis *et al.*, 1968) and in our own series of cases. Because of this the possibilities of surgical treatment have been widely explored in recent years.

Beck (1944) made the first attempt at surgical treatment of left ventricular aneurysm by reinforcing the involved area with a fascia lata autograft. Aneurysmectomy by a closed technique was reported by Likoff and Bailey (1955) and later by DeCamp (1956). Cooley *et al.* (1958) excised the first ventricular aneurysm with the aid of total cardiopulmonary bypass, and subsequently reports of other successful operations using this technique appeared (Lillehei *et al.*, 1962; Cathcart, Framow, and Templeton, 1963; Effler *et al.*, 1963; Lam, Gale, and Drake, 1964). More recently, several larger surgical series have been published, with excision done under total cardiopulmonary bypass in most cases (Favaloro *et al.*, 1968; Cooley and Hallman, 1968; Petrovsky, 1966; Lam *et al.*, 1966; Key, Aldridge, and MacGregor, 1968; Najafi *et al.*, 1969; Schattenberg *et al.*, 1970; Tice, Cheng, and Dolgin, 1970; Kay *et al.*, 1970).

The hospital mortality rate in two of the largest series using cardiopulmonary bypass was 13 per cent (Favaloro *et al.*, 1968) and 20 per cent (Cooley and Hallman, 1968), with a combined hospital mortality rate in these two series of 15.5 per cent. This is slightly less than our hospital mortality of 21.7 per cent where deaths up to 65 days after operation were included in hospital mortality.

Of the 18 patients in our series who survived operation, 16 were much improved as judged by physical examination, chest film, and improved exercise tolerance. This favourable outcome is reflected in most other surgical series. However, the immediate and late morbidity of surgical therapy must not be forgotten in the analysis of such series. Of our 18 patients surviving the immediate post-operative period in hospital, 2 suffered cerebral vascular accidents at the time of operation, probably related to embolism, with per-

manent sequelae. Cooley and Hallman (1968) also noted cerebral embolism to be the most serious non-fatal complication of operation in their series of 80 patients undergoing ventricular aneurysmectomy.

In spite of improvement in most patients surviving ventricular aneurysmectomy, the long-term mortality figures are not as favourable. Of our 18 patients surviving operation, 7 died during follow-up with a mean survival time of 26 months. Of these 7 patients, 5 died of recurrent myocardial infarction. Other reports (Schattenberg *et al.*, 1970) have emphasized the need for caution in the interpretation of long-term follow-up results, with recurrent myocardial infarction cited as a frequent cause of late death in many clinical and surgical series (Favaloro *et al.*, 1968; Gorlin *et al.*, 1967; Najafi *et al.*, 1969; Schattenberg *et al.*, 1970). Recent myocardial infarction is noted to be the single most common cause of death in the necropsy series of Schlichter *et al.* (1954) as well.

In view of the improved surgical methods for dealing with ventricular aneurysm, the necessity for improved diagnostic acumen is apparent. In two necropsy series, the diagnosis of postinfarction ventricular aneurysm was made before death in only 16 per cent (Dubnow *et al.*, 1965) and 6 per cent (Abrams *et al.*, 1963) of patients respectively, and of 10 patients with ventricular aneurysm described by Groden, James, and McDicken (1968), only one is said to have had clinical features suggesting this diagnosis. With increasing awareness of this diagnostic possibility, the frequency of diagnosis should improve. In the prospective study of Gorlin *et al.* (1967), an objective clinical clue to the diagnosis of ventricular aneurysm was present in 19 of 24 patients with cineangiographic evidence of aneurysm.

Continued symptoms of left ventricular failure after myocardial infarction are often the first clue to diagnosis. While these symptoms may be due to generalized myocardial disease, papillary muscle dysfunction with mitral insufficiency, ruptured interventricular septum, or to other causes not directly related to preceding infarction, a significant percentage of these patients will be found to have a localized ventricular aneurysm. Of the 23 patients in our series, 22 had dyspnoea before operation with activity very restricted by this symptom in 20 of these patients. In large necropsy series (Dubnow *et al.*, 1965; Schlichter *et al.*, 1954) congestive heart failure was a direct or contributory cause of death in 70–75 per cent of patients, while in the surgical series of Cooley and Hallman (1968), 74 per

cent of patients had symptoms of congestive heart failure before operation.

Angina pectoris was present in 8 of our patients before operation and was a severely limiting symptom in 5. Favaloro *et al.* (1968) report varying degrees of angina pectoris in 123 of 130 patients undergoing ventricular aneurysmectomy, while angina was present in 36 of 80 patients in another surgical series (Cooley and Hallman, 1968). Differences in patient selection are largely responsible for the wide variability in incidence of this symptom.

Serious dysrhythmias occurred in 5 of our patients before operation, with ventricular tachycardia and fibrillation being the most common. This complication played a major role in the decision to institute surgery in the majority of these patients. An incidence of 12.3 per cent of serious dysrhythmias is quoted in another large surgical series (Favaloro *et al.*, 1968). Magidson (1969) reported 3 patients who underwent ventricular aneurysmectomy for serious dysrhythmias: these patients were followed postoperatively for 11–45 months with no recurrence of dysrhythmia.

Clinical evidence of systemic embolism was present in 13 per cent of our patients. This compares with an incidence of 6 per cent (Favaloro *et al.*, 1968) and 12.5 per cent (Cooley and Hallman, 1968) in other surgical series. The incidence of thromboembolic phenomena noted in large necropsy series is much greater than this (Dubnow *et al.*, 1965; Schlichter *et al.*, 1954), in part because many emboli are not clinically detected. Schlichter *et al.* (1954) found thromboembolic phenomena to be a main cause of death in 22 per cent of their necropsy cases.

Physical findings were sometimes helpful in suggesting the diagnosis of ventricular aneurysm. An abnormal apex beat detectable by palpation was present in 91 per cent of our patients, and third or fourth heart sounds were present in all 23 patients. These findings are similar to those of Mourdjinis *et al.* (1968) who noted a high incidence of abnormal apex beats and third or fourth heart sounds in patients with ventricular aneurysm. Gorlin *et al.* (1967) noted an abnormal apex beat on palpation or apex cardiography in 16 of 24 patients with cineangiographic evidence of left ventricular aneurysm. In most patients, however, abnormalities of the apex beat are not specific, and other techniques are required for diagnosis.

Suggestive electrocardiographic changes are frequently present in patients with ventricular aneurysm. While Abrams *et al.* (1963) noted persistent ST segment elevation in only 1 of 65 patients in their necropsy series, other

clinical and necropsy reports (Gorlin *et al.*, 1967; Mourdjinis *et al.*, 1968; Schattenberg *et al.*, 1970; Groden *et al.*, 1968; Dubnow *et al.*, 1965) have cited a high incidence of persistent ST segment elevation. Eighty-seven per cent of our patients had ST segment elevation of one millivolt or greater in the appropriate leads before operation. All patients had evidence of transmural myocardial infarction with over 90 per cent of infarcts being anterior in location.

In our patients, the routine posteroanterior and lateral chest films were often helpful in diagnosis. Over half the patients had a localized bulge at the left heart border or apex suggesting the possibility of left ventricular aneurysm. Others (Mourdjinis *et al.*, 1968) have noted a high incidence of localized protrusion along the left heart border in cases of major ventricular aneurysm. On the other hand, Johnston *et al.* (1969) noted a deformity of the left cardiac border in only 10 per cent of their cases, and Dubnow *et al.* (1965) felt, on the basis of their necropsy series, that routine chest films rarely led to the diagnosis of ventricular aneurysm. Eight of our patients had only generalized left ventricular enlargement on routine chest film, emphasizing the need for more refined radiological techniques to detect a significant proportion of ventricular aneurysms. Only 2 patients had normal chest films. It has previously been noted (Baron, 1971) that aneurysms confined to the apical region are occasionally completely obscured by the diaphragmatic shadows, and this was the case in one of our patients with a normal preoperative chest film. The presence of pulmonary oedema or congestion in nearly half of our patients before operation emphasizes their precarious clinical status.

At the present time cardiac catheterization with left ventricular cineangiography is carried out in patients suspected of having ventricular aneurysm. The cineangiographic appearance of the left ventricle is the single most precise means we have of defining the nature and extent of left ventricular kinetic abnormalities, short of direct visualization. It is largely on the basis of this test that one must decide whether a patient's signs and symptoms are due to localized aneurysm formation, generalized myocardial dysfunction, or other causes. In the 18 patients in our study who had angiographic visualization of the left ventricular cavity before operation, there was generally excellent correlation between angiographic and surgical findings.

However, one of our patients felt to have a significant anterior aneurysm on the basis of left ventricular cineangiography was found to

have only a small area of anterior wall fibrosis with minimal systolic bulging of the surrounding area at the time of operation. This observation has also been made by other investigators who have emphasized the frequency and extent of disordered left ventricular contraction in patients with coronary artery disease (Gorlin *et al.*, 1967; Herman *et al.*, 1967; Herman and Gorlin, 1969) while pointing out that a cineangiographic appearance of akinesis or dyskinesis suggesting left ventricular aneurysm does not necessarily imply full thickness scar tissue replacement of the involved segment of left ventricular wall (Raphael *et al.*, 1972). In one report (Gorlin *et al.*, 1967), 2 of 16 directly observed patients meeting cineangiographic criteria for left ventricular aneurysm had aneurysmal bulging of viable myocardium, while in 7 others, mixed muscle and fibrosis was present in the area of cineangiographic abnormality. Only 7 of the 16 patients had aneurysms with thin fibrotic walls. Favaloro *et al.* (1968) likewise reported experience with a group of patients having an area of non-contractile left ventricular wall at the time of cineangiography, but in whom no line of fibrotic demarcation was noted at the time of operation. Though disordered contraction was noted at operation, no scar tissue was present, and on microscopical examination, predominantly viable myocardium was present in the area of cineangiographic abnormality. The portion of the coronary arterial tree supplying these areas of myocardium usually had significant occlusive lesions. It, therefore, appears that in a small proportion of patients with coronary artery disease a stable degree of myocardial ischaemia producing localized disorders of contraction fulfilling certain cineangiographic criteria for the diagnosis of ventricular aneurysm can exist without necessarily producing necrosis and scar tissue. This will be discovered at the time of operation when the surgical approach would involve attempts to improve the blood supply to the involved area of myocardium, not resection of the akinetic segment of left ventricular wall.

Published reports of haemodynamic evaluation in patients with left ventricular aneurysm are few. In a detailed haemodynamic study and analysis of 13 patients with ventricular aneurysm, Klein, Herman, and Gorlin (1967) showed that involvement of more than 20 per cent of the left ventricular surface by non-contractile tissue will necessarily produce haemodynamic abnormalities such as increased end-diastolic pressure and volume, whereas smaller aneurysms may be associated with near normal haemodynamics. In our

patients, the left ventricular end-diastolic pressure, end-diastolic volume, cardiac index, and pulmonary artery pressure were abnormal in the great majority of patients in whom these parameters were measured, reflecting the extent of aneurysmal involvement in these patients.

One of our patients studied both before and after operation showed evidence of haemodynamic and angiographic improvement after operation, confirming the clinical impression. Other studies (Kay *et al.*, 1970; Cooley, Hallman, and Henly, 1964; Greenwood, Aldridge, and Wigle, 1965; Harman *et al.*, 1969) in small numbers of patients have cited improvement in haemodynamic parameters after operation for ventricular aneurysm.

Selective coronary arteriography is necessary for adequate evaluation of patients suspected of having ventricular aneurysm, and is now routinely preferred in our patients. Long-term survival in the majority of patients after ventricular aneurysmectomy is limited by the extent of underlying coronary artery disease. Accurate preoperative evaluation of coronary artery anatomy enables more accurate judgement of the surgical risks and long-term prognosis to be made, and also serves as a guide to surgical intervention, particularly if aorto-coronary bypass operation is contemplated in addition to aneurysmectomy. Nearly all our patients in whom information concerning the coronary circulation was available had total or near total occlusion of the left anterior descending artery. Over half the patients had less severe narrowings in other portions of the coronary tree as well. This striking predominance of left anterior descending coronary artery involvement with associated anterior or apical aneurysms is well known and reflected in other surgical series (Favaloro *et al.*, 1968; Cooley and Hallman, 1968). Superior collateral circulation over the inferior surface of the heart and higher early mortality in patients with extensive inferior infarction, because of associated papillary muscle involvement with secondary mitral regurgitation, have been cited as explanations for the small numbers of inferior wall aneurysms in surgical series (Favaloro *et al.*, 1968; Tice *et al.*, 1970; Effler, Groves, and Favaloro, 1965).

Favaloro *et al.* (1968) emphasize the poorer long-term prognosis after operation for ventricular aneurysm in those patients with significant occlusive disease in portions of the coronary arterial tree other than that branch whose occlusion led to aneurysm formation. With the advent of aorto-coronary saphenous

vein bypass techniques, the combination of left ventricular aneurysmectomy with vein bypass grafting to other parts of the coronary circulation offers a means of improving long-term prognosis in selected patients (Johnson and Lepley, 1970; Milstein, 1970). The increased surgical risks of such a combined procedure as well as the effects on long-term survival rates have yet to be determined. Only 2 of our patients had combined procedures. One died shortly after operation and the other is doing well with only a short period of follow-up.

Our findings at the time of operation reflect those in other published series (Favaloro *et al.*, 1968; Cooley and Hallman, 1968; Dubnow *et al.*, 1965; Schlichter *et al.*, 1954). All aneurysms involved the anterior wall or apex with no isolated inferior wall aneurysms. Mural thrombus was present in 78 per cent of our cases.

In the analysis of surgical results, the manner in which patients are selected must always be considered. The type of patient selected for operation will have an important effect on the immediate and long-term results of operation. If our series of 23 patients is divided into the group of 5 who died before hospital discharge after aneurysmectomy, and the remaining 18 patients who survived the immediate postoperative period in hospital, important differences are immediately seen. All 5 patients dying in hospital had dyspnoea at rest before operation, while only 2 of the other 18 patients had dyspnoea of this severity. The mean time interval from acute myocardial infarction to onset of signs or symptoms of ventricular aneurysm was shorter in the group of 5 patients dying in hospital as was the mean time interval from myocardial infarction to operation. It is obvious that the surgical mortality in a group of severely ill patients requiring operation in the early stages after myocardial infarction will be higher than in those patients in whom operation can be delayed. Early operation is sometimes unavoidable, and 3 of our patients undergoing aneurysmectomy four months or less after acute myocardial infarction did well. Nevertheless, we would agree that aneurysmectomy should be delayed, if possible, for several months after acute myocardial infarction (Favaloro *et al.*, 1968; Lam *et al.*, 1966).

The selection of patients for ventricular aneurysmectomy is a very difficult task. The patient's prognosis without operation must be weighed against the long- and short-term benefits of surgery as well as the surgical morbidity and mortality. It must be remembered that many patients live long, relatively normal

lives with this condition (Master *et al.*, 1954; Hanbury, 1957). With constant changes and improvements in surgical technique, it is impossible to evaluate the risks and benefits of current surgical methods with precision. Furthermore, the natural history of this condition in patients of various symptomatic classes is not well documented. The wide spectrum of left ventricular kinetic abnormalities in patients with coronary artery disease makes it difficult in some cases to determine whether a given left ventricular cineangiographic abnormality accounts for a patient's signs and symptoms. Because of these vagaries criteria for surgical intervention are difficult to establish.

In general, we consider the possibility of ventricular aneurysmectomy in all patients with severely limiting symptoms of dyspnoea or angina, serious dysrhythmias, or systemic embolism. If, after clinical and laboratory evaluation, these manifestations are felt to be secondary to ventricular aneurysm, operation is advised. The status of the remainder of the coronary circulation is taken into consideration, particularly if additional coronary artery surgery is being contemplated.

We feel that ventricular aneurysmectomy is indicated in a carefully selected group of patients. The effect on longevity cannot yet be adequately evaluated, but appears to depend in large part on the status of the remaining coronary circulation.

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