Ventricular aneurysms and akinesis

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Formerly, paradoxical movement of the left ventricular wall was considered the main factor causing impaired left ventricular performance. At present, experimental and clinical studies have shown that in the area of the myocardium where wall motion is absent, insufficient tension is developed to accomplish fiber shortening, with the result that fiber shortening and tension development in the remaining areas of the ventricle must increase to maintain an adequate stroke volume. When 20% to 25% of the left ventricular wall becomes akinetic, ventricular dilatation must ensue if the limits of fiber shortening of the healthy muscle are not to be exceeded.

When ventricular dilatation occurs as a consequence of the former mechanism, the physiopathology of the left ventricular function can be explained purely on a mechanical basis by Laplace's law of membranes. Thus, for a ventricle twice as large as another, four times as much tension must be developed within its wall to maintain the same pressure.

This additional requirement in wall tension is reflected in additional myocardial oxygen requirement that an impaired coronary circulation may not be able to meet. Surgical excision permits the maintenance of the intraventricular pressure with less wall tension and, at the same time, improves ventricular performance and relieves angina. Adequate revascularization of the remainder of the ventricle when needed must logically insure a better prognosis in terms of control of angina and recovery of cardiac function.

According to these principles, the surgical treatment of postinfarction ventricular aneurysm and akinesis should realize the maximal reduction of the different radii of the left ventricular cavity by excision or exclusion of all akinetic areas. Conventional anterior aneurysmectomy confined excision to the diseased myocardium in the free wall of the left ventricle. However, in most anterior aneurysms of the left ventricle the septum is involved so it becomes necessary to admit that this conventional procedure realizes only a partial aneurysmectomy.

After the report from Stoney et al in 1973, describing the technique of exclusion of the septum in the treatment of ventricular aneurysms, we have tried to adapt ventricular resection to the extension and location of the akinetic areas. In the usual situation when the aneurysm involves the septum, the ventriculotomy is closed using three rows of sutures reinforced with Teflon strips, suturing the lateral edge of the myocardium to the junction of the scar and the normal myocardial tissue on the septum.

When the anterior wall of the right ventricle is also involved, the resection of the aneurysm implies the opening of both ventricles. The anterior portion of the septum can be excised and the repair is completed, joining the edges of the right ventricle, septum, and left ventricle. In rare instances where the aneurysm and mural thrombus are limited to the interventricular septum, it is not necessary to excise any portion of the free ventricular wall of the left ventricle. The thrombus is then removed as completely as possible through a longitudinal left ventriculotomy and closure is accomplished, suturing the left edges of the ventricular wall to the junction of the scar and the healthy muscle and the septum with the technique previously described. Conventional aneurysmectomy is reserved for cases of true anterolateral, lateral, or posterobasal aneurysm in which the diseased myocardium is confined to the free wall of the left ventricle. In such cases, the anterior descending coronary artery is preserved and can be revascularized.

From 1972 through April 1977, 66 patients underwent resection of left ventricular aneurysms in our unit. In 84% of the patients there was involvement of the septum. Hospital mortality was 12% (eight patients). A chronological analysis of this mortality has rendered it possible to observe a progressive reduction. We consider this improvement has resulted from two main factors, namely, better myocardial protection during the procedure and associated myocardial revascularization by coronary bypass grafts. The influence of myocardial protection in the operative mortality is shown in *Table 1.* In the group of 11 patients in which the aorta was cross-clamped under conventional hypothermia (28 C), five patients died (four from low cardiac output). In the group of 55 patients operated upon under deep local hypothermia in which aortic cross-clamping was

Table 1. Influence of myocardial protection

Ventricular aneurysm Method	Myocardial protection vs. mortality: Cases	Mortality
Aortic clamping under gral. hypothermia (28 C)	11 (1*)	5 = 45%
Deep local hypothermia with or without aortic clamping	55 (27*)	3 = 5%

*With CABG
$p < 0.01$

Table 2. Influence of associated revascularization

Ventricular aneurysm	Revascularization vs. mortality: Cases	Mortality
Aneurysmectomy only	38	8 = 21%
Aneurysmectomy + CABG	28	0
CABG × 3 = 2 cases		
CABG × 2 = 7 cases		
CABG × 1 = 19 cases		

$p < 0.025$

used only to perform distal graft anastomoses to the left coronary branches, the mortality was only 5% ($p < 0.01$). The influence of associated revascularization on the mortality is shown in *Table 2*. There were no mortalities in the group of cases in which coronary artery bypass grafting was associated with aneurysmectomy. The total mortality of eight cases was encountered in the group of patients in which aneurysmectomy was complemented by myocardial revascularization ($p < 0.05$).

We have performed cardiac catheterization preoperatively in 36 patients. Preoperative and postoperative ventriculograms have been compared. There was a mean reduction of 33% in end-diastolic volumes (from 282 ± 124 cc to 190 ± 54 cc) and of 50% in end-systolic volumes (from 179 ± 111 cc to 91 ± 41 cc). These postoperative figures are very close to the upper level of normality in our laboratory: 175 cc for end-diastolic and 75 cc for end-systolic volumes. The ejection fraction increased from 0'38 ± 11 preoperatively to a normal figure of 0'53 ± 10 postoperatively.

In conclusion, we consider it necessary to adapt the technique of aneurysmectomy to the anatomic location and extension of the fibrotic scar. This implies the necessity to exclude the akinetic zone of the septum in most patients. Adequate myocardial protection and additional revascularization of the right and circumflex coronary arteries when indicated are followed by a marked improvement in operative mortality. Complete myocardial revascularization and restoration of nearly normal left ventricular volumes make it possible to expect a better and longer survival in these patients than in those in whom only conventional section was performed and associated revascularization was not accomplished.