Short-Term Follow-Up of Patients After Aneurysmectomy of the Left Ventricle

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Objective – *Left ventricular aneurysm is a complication of myocardial infarction that can best be treated by reconstructive surgeries that can restore ventricular geometry. We analyzed immediate results in a group of consecutive patients who underwent surgical correction of left ventricular aneurysms.*

Methods – *From January '90 to August '99, 94 patients - mean age 58.4 (ranging from 36 to 73 years), 65 (69.1%) males and 9 (30.8%) females - were operated upon. Pre-operative ejection fraction ranged from 0.22 to 0.58 (mean = 0.52), and the aneurysm was located in the antero-lateral area in 90.4% of the cases. Functional class III and IV (NYHA) was present in 82 (87.2%) patients, and 12 (12.7%) were in functional class I and II. Congestive heart failure was the most frequent cause (77.6%), occurring in isolation in 24.4% or associated with coronary artery diseases in 53.2%.*

Results – *Short-term follow-up showed a 7.4% mortality, and low cardiac output was the main cause of death. Coming off pump was uneventful in 73 patients (77.6%), with a 3.2% mortality and with the use of inotropics in 20 (21.3%). One patient (1%) did not come off the pump.*

Conclusion – *Surgical correction was adequate in the immediate follow-up of operated patients, and mortality was higher in patients with higher functional class.*

Keywords: Coronary artery disease, left ventricular aneurysm, myocardial revascularization, cardiac surgery

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Ventricular aneurysms are serious complications of transmural myocardial infarction, leading to severe hemodynamic compromise (heart failure, thromboembolism, angina, and arrhythmias), occurring in 5 - 30% of the patients, and leading to a great number of deaths in patients with a proximal obstruction in the left anterior descending artery [1-3].

Transesophageal echocardiography and ventriculography are the best diagnostic methods because they allow visualization of akinesis or even dyskinesis during ventricular systole, with bulging of the cavity, decreased wall thickness, missing trabeculae, transition area with remaining muscle (opening), and occasional intracavitary thrombus. Surgery has been frequently indicated, and it improves symptoms and the quality of life, with a better survival [4-6]. Congestive heart failure, systemic arterial thromboembolism, and ventricular arrhythmias are the main reasons for surgery. However, several times aneurysmectomy is performed together with myocardial revascularization in patients with angina.

This study analyzes the early results in patients who underwent left ventricular aneurysmectomy at our institution.

Methods

From January '90 to August '99, 94 patients underwent left ventricular aneurysmectomy either in isolation or in association with myocardial revascularization. Sixty-five were males (69.1%). The mean age was 58.4 years, ranging from 36 to 73. A clinical examination showed that 73 patients (77.6%) had signs and symptoms of congestive heart failure, such as dyspnea on light and medium effort or even at rest, with or without edema of the lower extremities. Six of these (6.4%) had episodes of acute paroxystic dyspnea, and 3 (3.2%) had acute pulmonary edema. Twenty-three patients (24.4%) had isolated signs of congestive heart failure, and 50 (53.2%) had symptoms of heart failure together with angina. Angina alone was present in 20 (21.3%) of the cases. Seventy-three (77.6%) patients were on digitalis, diuretics or

vasodilators; 4 (4.2%) had syncope (in two cases associated with serious ventricular arrhythmia). Severe ventricular arrhythmia was present in 17 (18.1%) patients. At the time of surgery, 3 (3.2%) patients were in NYHA functional class I, 9 (9.6%) in functional class II, 71 (75.5%) in functional class III, and 11 (11.7%) in functional class IV.

Left ventricular aneurysm was secondary to myocardial infarction in 92 patients (97.9%) and to Chagas' disease in two (2.1%). Eighty-five (90.4%) patients had had an antero-septal and extensive lateral myocardial infarction, while 9 (9.6%) had had an inferior infarction.

The time between last infarction and surgery ranged from 35 to 90 days, with a mean value of 45 days. Mean value for preoperative ejection fraction was 52 %.

Surgery was indicated due to symptoms derived from the aneurysm in 23 (24.4%) patients (dyspnea, congestive heart failure, arrhythmia), due to coronary artery disease with angina in 18 (19.1%), and due to both in 50 (53.2%). In 3 (3.2%) patients, surgery was indicated because of the presence of a serious ventricular arrhythmia with severe symptoms. In 64 patients (68.1%), aneurysmectomy was associated with myocardial revascularization, one (1%) had associated mitral valve replacement, and one (1%) associated mitral and pulmonic commissurotomy. In 28 (29.8%) patients, aneurysmectomy was the only surgery performed (table I).

The surgical technique used was a longitudinal thoracotomy and median sternotomy. Extracorporeal circulation with a single cavo-atrial cannula in the right atrium and ascending aorta cannulation were employed. Moderate systemic hypothermia at 28º C was maintained. Surgery was performed with intermittent clamping of the aorta in patients who underwent isolated aneurysmectomy, and cold cardioplegia in the aortic root was associated in the other patients.

Surgery was performed using the technique described by Jatene [7] in 87 (92.5%) patients, using Braile's semirigid prosthesis in six (6.4%) and a bovine pericardial patch in 1 (1%).

After extracorporeal circulation was installed, patients were kept under 32º C hypothermia, with preserved heart beats and intermittent clamping of the ascending aorta. The location of the aneurysm was identified and left ventriculotomy was performed on the fibrotic area. While the heart was still beating, the area of the aneurysm was defined by digital palpation. Plication of the fibrotic area of the ventricular septum was performed followed by banding of the aneurysm orifice with a purse-string suture at the transition from fibrosis to normal contractile tissue. Separate U stitches with a 0 Ethicon suture on Teflon felt were applied to the area limited by the purse-string suture, and the ventriculotomy could then be directly closed without the use of a patch. The excessive fibrotic tissue was then excised and the suture reinforced with a continuous suture, using the same sutures that had been previously applied. Air was taken out from the apex of the left ventricle and by aspiration of the ascending aorta.

In patients in whom the semirigid prosthesis was used, the technique was similar except for the use of U separate stitches with a 2-0 tbond suture, supported on Teflon pledgets that surrounded the transitional area, instead of the purse-string suture. The diameter of the prosthesis was chosen according to measurements obtained with a specific instrument and by observing the residual cavitary volume. After the prosthesis was chosen, the stitches were applied to the prosthesis that was then sutured to the orifice of the aneurysm resulting in a new ventricular wall. The bovine pericardium patch was sutured with a continuous suture using a 2-0 etbond suture to reinforce the area of fixation and promote hemostasia. The aneurysmatic area of the left ventricle was not excised, and it was sutured upon the prosthesis.

In patients who also underwent coronary artery bypass grafting, a temperature of 28º C was obtained after the correction of the aneurysm, the ascending aorta was clamped, and a cold cardioplegia blood solution at 4º C was infused into the aortic root every 20 minutes. The distal anastomoses, left internal thoracic artery, coronary artery, or saphena-coronary artery were performed. The proximal saphena-aorta anastomoses were performed with intermittent clamping of the aorta. Left atrial pressure was monitored in all patients, and the Swan-Ganz catheter was used in the presence of a low output state.

Revascularization of the coronary arteries supplying the area of the aneurysm was performed whenever these arteries were pervious. A graft in the area of the aneurysm was used in 29 patients (30.85%), all in the anterior wall, either in the anterior interventricular artery or in its diagonal branches.

In isolated correction of the left ventricular aneurysm, the time of extracorporeal circulation ranged from 30 to 54 minutes, and the aorta clamping from 10 to 30 minutes.

Table I – Performed Surgeries

Procedure	Number	%
Isolated Aneurysmectomy	23	24.4%
Aneurysmectomy + 1 graft	23	24.4%
Aneurysmectomy + 2 grafts	25	26.6%
Aneurysmectomy + 3 grafts	14	14.9%
Aneurysmectomy + 4 grafts	7	7.4%
Aneurysmectomy + mitral valve replacement	1	1%
Aneurysmectomy + mitral and pulmonary commissurotomy	1	1%

Results

Demographic characteristics of the patients are similar to those described in other studies in the literature, with a higher prevalence of males and mean age above 50 years. Older age was associated with a higher mortality. The clinical status of the patients and the surgical indication were related to the presence of heart failure and angina, and most patients were in functional class III.

The anterior wall and the coronary arteries responsible for its supply were involved in 85 patients (90.4%).

Early mortality was 7.4%, and a low cardiac output was the main cause of death. Coming off pump was uneventful in 73 patients (77.6%), with a 3.2% mortality. In 20 patients (21.3%), inotropic drugs were necessary, and one patient (1%) did not come off the pump, all of which resulted in a mortality rate of 19%. The mortality rate was 7% in patients in functional class III, 18.2% in functional class IV, and no operated patient in functional class I or II died (tab. II).

Discussion

Invasive techniques in the management of acute myocardial infarction (thrombolytic therapy, coronary artery angioplasty, and coronary artery bypass graft) may avoid or decrease the extension of myocardial lesions and the formation of a left ventricular aneurysm. However, after the establishment of an aneurysm and its symptoms, surgical treatment is better than clinical treatment in terms of improving symptoms and quality of life, with a better survival [5-13].

Delays in the diagnosis and in referring patients for surgery decreases survival and increases the risk of late complications [5].

Several surgical techniques have been proposed [14] to treat ventricular aneurysms complicating myocardial infarction with severe hemodynamic compromise (plication, excision and suture, imbrication, and patch placement).

Surgical treatment of a left ventricular aneurysm was first performed in 1944, when Beck placed a patch of *fascia lata* over the fibrotic area in an attempt to reduce systolic expansion and avoid rupture. Likoff and Bailey [15] in 1955 performed a closed ventriculoplasty using a surgical instrument that was especially designed for that. A few years later, Bailey reported five survivors among six cases treated with this method. But the first surgical resection of an aneurysm complicating a left ventricular infarction using extracorporeal circulation was performed only in 1958 by Cooley and cols.[16]. After that, several surgical techniques have been reported for the correction of aneurysms, with variable and discordant results and high mortality in some studies.

Aneurysms with a large orifice were still difficult to treat until Jatene [7] in 1985 reported the technique of geometrical reconstruction of the left ventricle, thus eliminating unfavorable factors for the correction, such as a nonsignificant reduction in ventricular volume, suppression of the septal dyskinetic area, and maintenance of an elliptical ventricular form.

The efficacy of this type of reconstruction stimulated the appearance of similar techniques, using rigid or semirigid prostheses to reestablish normal geometry, especially when surgery for the ventricular aneurysm was indicated

Branco and cols.[17] in 1982 described a Teflon and Dacron prosthesis, with wide rims, that had a rigid format. Maybe the rigidity and the use of large diameters, with the concept of simply closing the aneurysm without reducing its orifice, may explain why this technique was abandoned. Braile and cols. [18] in 1991 presented a similar prosthetic model, which was made of biological material (bovine pericardium) preserved in glutaraldehyde and placed on a semirigid ring, allowing for maintenance of the diastolic volume and absence of distortion during systole, with good clinical results. Recently, Cooley and cols. [16,19] reported the technique of endoaneurysmorrhaphy using a bovine pericardium patch.

Since the early days of cardiac surgery until now, most series in the literature have reported a high mortality rate for the surgical treatment of left ventricular aneurysm, ranging from 2 to 19% (mean 9.9%) [9,15,20-33].

Several risk factors have been identified as being associated with high mortality but the technique used to correct the aneurysm, together with the preoperative status of the patients, certainly represents an important factor in the immediate surgical result.

The surgical result depends on a good ventricular function in the preoperative period, and it is associated with the adequate correction of the left ventricular cavity [34,35]. Jatene's technique [7], which was used in the majority of these patients, is adequate because it precisely evaluates the extension of the muscular lesion and the muscular mass to be excised. It also corrects septal distensions and dyskinesis, avoids long and linear sutures that deform the heart, and eliminates the use of patches to close the ventriculotomy in most cases. We obtained similar results with Braile's semirigid prosthesis, which also eliminates linear sutures and, consequently, avoids large ventricular deformities. Nicolosi and cols. [36] in an experimental study didn't find a significant hemodynamic difference between long linear correction and the use of a patch. Global hospital mortality at the time of the present study was 7.4%, which is slightly lower than mean values reported in the literature (9.9%) and higher than the first results reported by Jatene (4.3%) [7]. Cardiac causes were either directly or indirectly related to death in 85% of the cases, and low cardiac output secondary to acute myocardial failure was the main cause of death, which has also been the experience of others [3,24,37].

Several authors [11,14,37,38] have identified the following risk factors: the extension of the coronary artery disease, with involvement of three or more arteries; the extension of previous myocardial infarction reflected in the patient's clinical status as functional class IV; the presence of symptoms of significant heart failure with or without angina; severely depressed ventricular function (ejection fraction

Table II – Mortality rate according to NYHA functional class (FC)

NYHA FC	Number	Mortality	
		Number	%
I	3	0	0
II	9	0	0
III	71	5	7.04%
IV	11	2	18.18%

<0.30 and end-diastolic pressure >25mmHg), and age above 65 years. These factors, either isolated or in association, were present in all patients who died.

Among other risk factors that are frequently mentioned, tachyarrhythmias and ventricular arrhythmias [21,39] occurred in only one operated patient, who died on the second day in the postoperative period. This patient also had other associated risk factors, such as age and acute mitral insufficiency postmyocardial infarction.

A bovine pericardium patch was used in only one patient at the beginning of our experience, and it has been shown to be related to a higher mortality in other studies [9,34].

A complete study, an adequate preoperative assessment, efforts to decrease causes of increased surgical risk whenever possible, and an adequate and careful management of patients after surgery can help to obtain better results.

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