ASSESMENT OF THE LEFT VENTRICLE FUNCTION WITH NUCLEAR VENTRICULOGRAPHY DURING DOBUTAMINE STRESS TEST AFTER CLASSICAL ANEURYSMECTOMY AND ENDOANEURYSMORRAPHY

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The aim is to asses the left ventricle function with nuclear ventriculography during dobutamine stress test after classical aneurysmectomy and endoaneurysmorraphy. Twenty-one patients were enrolled in the study. The patients in group 1 (n=10) and group 2 (n=11) underwent conventional resection and endoaneurysmorrarpy, respectively. The patients were evaluated by nuclear ventriculography at rest preoperatively, and both at rest and during dobutamine stress test postoperatively. The preoperative (preop) global EFs in group 1 and 2 were 29.9±4.3 and 24.5±4.2, respectively, (p<0.05). The mean global EFs in group 1 and 2 at rest increased to 39.6±6.5 and 35.8±5.4, respectively, after the surgery (p<0.05).
The mean global EF and the EFs in segments 1 and 4 increased during dobutamine stress test in group 1 (p<0.05). An increase in segments 2, 3, 6, and a decrease in segment 5 were detected (p>0.05). The mean global EF and the EFs of the segments 1,2,3 and 6 increased during dobutamine stress test in group 2 (p<0.05).
At the late postoperative (postop) period, in patients who underwent classic aneurysmectomy or endoaneurysmorraphy, LV global and segmenter EFs increased during dobutamine stress test. The increase in patients with classic aneurysmectomy is as good as that of patients with endoaneurysmorraphy.

Key words: Left ventricular aneurysm, aneurysmectomy or endoaneurysmorraphy, dobutamine stress nuclear ventriculography

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The incidence of LV aneurysm after myocardial infarction (MI) is reported to be 10-31% [1,2]. Concomitant cardiopulmonary bypass with LV aneurysmectomy was first performed by Cooley et al, who used the classical aneurysmectomy technique [3]. Many surgeons still use this technique for the treatment of LV aneurysms [2,4,5]. However, in patients with large aneurysms, alternative LV reconstruction techniques are required. It is reported that circular closing of the ventricle after aneurysmectomy preserves cardiac anatomy better than linear closing does [6].

After LV reconstruction, cardiac performance can be assessed by echocardiography [7,8], radionuclide ventriculography [9], ultrafast computed tomography [10,11] and gated magnetic resonance imaging [12,13]. Multiple-gated acquisition (MUGA) scaning is one of the accepted methods for the essessment of the left ventricular systolic function. It is particulary suitable for the assessment of ventricular function in steady state. [14]. Although, there are many investigations about late hemodynamic effects of classical aneurysmectomy or endoaneurysmorraphy, only a few had been performed during exercise.

The aim of the study was to asses the left ventricle function with nuclear ventriculography during dobutamine stress test after classical aneurysmectomy and endoaneurysmorraphy.

PATIENTS AND METHODS

Between January 1992 and September 2000, 84 patients with LV aneurysm had either conventional resection or endoaneurysmorraphy procedure in our department. Among these patients, twenty-one males who had consented to the study protocol were enrolled in this study. These patients were evaluated by nuclear ventriculography at rest preoperatively. The patients were divided into two groups. The patients in group 1 (n=10) underwent classical aneurysmectomy and the patients in group 2 (n= 11) underwent endoaneurysmorraphy procedure. In patients with large aneurysms, we prefered endoaneurysmorraphy; however if the patients had a small and well-bordered aneurysm, the classical technique was prefered.

The study was approved by the ethical committee of Akdeniz University Medical School. The patients who had simultaneous LV aneurysmectomy and full revascularization were called back for re-examination. In all patients a LIMA graft was used for LAD coronary artery revascularization. The patency of the grafts were confirmed by coronary angiography in all cases. An informed consent was obtained before enrolling the patients to the study. Patients who had angina pectoris, hypertension, mitral insufficiency and arrhythmia were excluded. All medications were discontinued 3 days before dobutamine stress ventriculography. Cardiac rhythm and blood pressure monitorization (LOHMEIER M 111-384 D-81241, München, Germany) were made before and throughout the procedure. Dobutamine was infused through a peripheral vein starting from a dose of 10 mg/kg/min, and increased by 10 mg/kg/min every 3 minutes to a maximum dose of 40 mg/kg/min. The peak dose was continued for 6 minutes. Those who did not achieve 85% of the age-predicted maximal exercise heart rate were given 0.25 mg atropine sulfate intravenously during dobutamine infusion. The ECG was continuously monitored throughout dobutamine infusion, a 12-lead ECG was taken every minute and the blood pressure was measured every 3 minutes. In case of ST segment depression or elevation > 2 mm 80 ms after the J point , ventricular tachycardia, angina pectoris, systolic blood pressure > 160 mmHg or diastolic blood pressure >100 mmHg or any complication considered to be due to dobutamine or atropine, infusion was terminated. In group 2, one patient had angina pectoris with ventricular arrhythmia and excluded from the study. Only two patients, one from each group required additional 0.25 mg atropin sulfate.

All the patients were evaluated by nuclear ventriculography (20 mCi technetium Tc 99m) at rest preoperatively, and both at rest and during dobutamine stress test postoperatively. Left anterior oblique and left lateral views (10 min each) were taken with a gamma camera (GCA 602-A, Toshiba; Osaka, Japan) using a

LEGP (Low Energy General Purpose) setting. Views were taken in a 64X64 matrix, at the rate of 16 frames per minute. Every heart cycle was divided into 16 equal frames by using an electrocardiographic trigger. Segmental and global EFs were calculated. In the short axis, the LV was divided into 6 equal parts to evaluate the segmental and global EFs. The numeric values of the segments and their corresponding ventricular walls are given in Figure 1.

Surgical Technique

Median sternotomy was used for all patients. Before cardiac arrest, the region of the aneursym was evaluated visually. After cardiopulmonary arrest with cold crystalloid potassium cardioplegic solution, we induced mild systemic hypothermia (28 to30 ∞C) and topical cooling with cold saline. In classical aneurysmectomy, we preserved the left anterior descending coronary artery and incised the aneurysm. Any thrombus that was found was removed. Scarred, noncontractile tissue of the aneurysm was excised, leaving a margin of fibrous tissue for approximation. Both sides of the incision were sutured using 2-0 polypropylene buttressed with longitudinal Teflon strips.

In the endoaneurysmorraphy group, we incised the aneurysm. After locating the junction between fibrous and viable tissue, we prepared 3D Woven Fabric patch (Intervascular; Clearwater, Fl, USA) of appropriate size and shape for the defect. The patch was continuously sutured to the fibrous tissue at the edge of the junction with 3-0 polypropylene. The remaining aneurysmal wall was closed over the patch with 2-0 polypropylene.

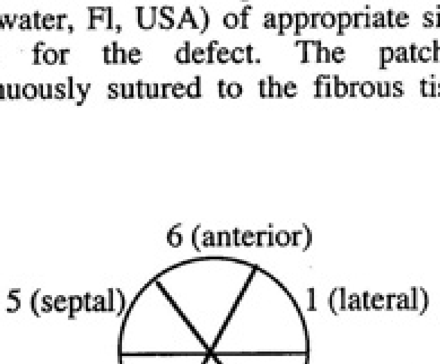

Figure 1. Definition of the segments and their corresponding ventricular walls which were used for scintigraphic evaluation

Table 1. The Clinical Charecteristics of both groups

	Classical Aneurysmectomy N= 10 (Group 1)	**Endoaneurysmorrphy** N=11, (Group 2)	*p value*
Mean age (range)			
	53.1±7.6 (42-64)	58.6±4.9 (49-66)	>0.05
Sex (M/F)			
	10/0	11/0	>0.05
Site of the aneurysm			
AL, AP			
	8	8	>0.05
AL, AP, INF			
	2	3	>0.05
Mean follow-up after surgery (yrs) (range)			
	2.5±0.7 (2-4)	2.3±0.8 (2-4)	>0.05
Mean number of coronary artery (range)			
	1.9±0.5 (1-3)	1.7±0.2 (1-2)	>0.05
Mean number of CABG (range)			
	1.8±0.4 (1-3)	1.6±0.7 (1-3)	>0.05

AL= anterolateral, AP=apical, INF=inferior

Statistics

Statistical analysis was performed using the SPSS for windows. All values were presented as mean ± standard deviation. The corresponding variables in the two independent groups were compared by the Mann-Whitney U test and the paired variables within the same group were compared by the Wilcoxon Signed Rank test. We also applied 2 (Classic aneurysmectomy and endoaneurysmorraphy groups) ¥ 2 (preop and postop measures) Repeated Measures Analysis of Variance Model. P values less than 0.05 were considered significant.

RESULTS

There was no difference of the mean age, follow-up times after surgery, number of coronary arteries involved, number of CABG between of the groups 1 and 2, whereas there was a significant difference between the preop mean global EFs of two groups (29.9±4.3 and 24.5±4.2) (Table 1)

In group 1 (classical aneurysmectomy), the mean preop and postop EFs at rest were 29.9±4.3 and 39.6±6.5, respectively. In group

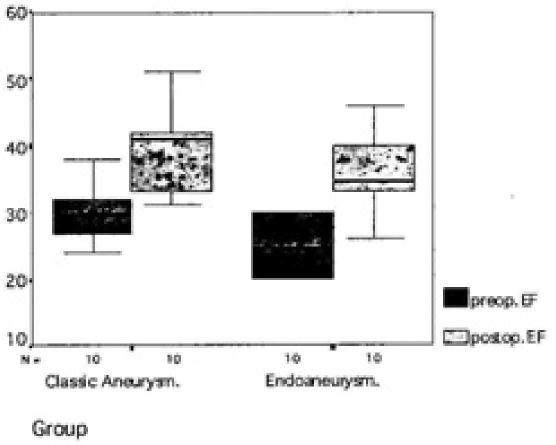

Figure 2. Left ventricular preoperative EFs in groups 1 and 2 significantly increased after the surgery.

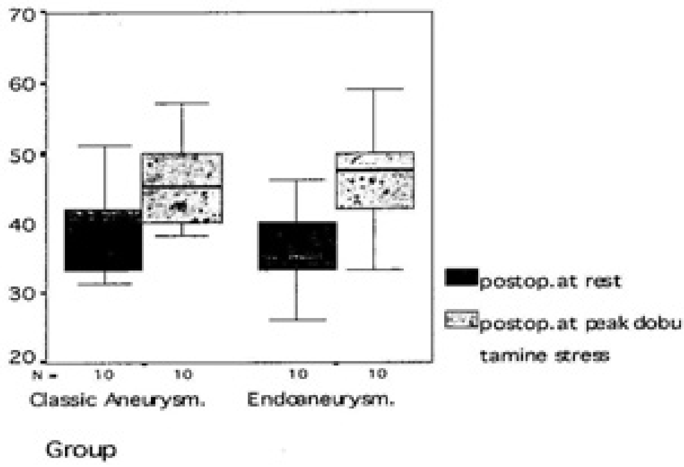

Figure 3. Left ventricular postoperative EFs in groups 1 and 2 at rest significantly increased during peak dobutamine stress

2 (endoaneurysmorraphy), the mean preop and postop EFs at rest were 24.5±4.2 and 35.8±5.4, respectively. There were statistically significant increases in ejection fractions in both groups ($p<0.05$; fig 2). When the groups were compared with each other, difference of mean EF increase in both groups was insignificant ($p>0.05$).

In group 1, the mean global EF and the EFs of the segments 1 and 4 increased during peak stress($p<0.05$). Also an increase in segments 2, 3, 6 and a decrease in segment 5 were detected, but these differences did not show statistical significance ($p>0.05$). Global and segmental ejection fractions both at rest and during peak stress are shown (Table 3). In group 2, the mean global EF and the EFs of the segments 1,2,3 and 6 increased ($p<0.05$). Global and segmental ejection fractions of patients at rest and peak stress in group 1 are shown (Table 3).

After surgery, the mean global EFs of the groups 1 and 2 at rest increased from 39±6.5 and 35.8±5.4 to 45.6±5.7 and 46.9±7.8, respectively, during peak stress ($p<0.05$; fig 3).

DISCUSSION

The aim of surgical treatment of LV aneurysm

Table 2. Outcomes of dobutamine stress test in both groups

Variable	Classical Aneurysmectomy	Endoaneurysmorrphy	*p value*
Mean heart rate at rest (range)			
	72.5±6.0 (66-87)	78.0±7.8 (66-94)	>0.05
Mean dobutamine dose (mgr/kg/min) (range)			
	29.0±7.3 (20-40)	26.3±6.7 (20-40)	>0.05
Mean peak stress heart rate(range)			
	137.2±6.5 (128-145)	131.8±8.1 (115-146)	>0.05
Mean peak stress blood pressure (range)			
	141.8±10.1 (121-155)	144.3±13.1 (119-162)	>0.05
Preop. Mean EF(%) at rest			
	29.9±4.3	24.5±4.2	<0.05
Postop. mean EF (%) at rest			
	39.6±6.5	35.8±5.4	>0.05
Postop. mean EF (%) at peak stress			
	45.6±5.7	46.9±7.8	>0.05

Table 3. At rest and peak dobutamine stress test global and segmentary ejection fractions of patients in groups 1 and 2.

	Group 1			Group 2		
	At rest	Peak stress	P value	At rest	Peak stress	P value
S1	59.8±12.3	69.5±8.7	=0.02	58.8±13.5	66.4 ±12.4	=0.03
S2	57.8±17.1	66.7±11.2	=0.06	53.0±14.4	68.2±16.2	=0.01
S3	31.9±10.2	43.0±19.1	=0.1	30.5 ±11.1	49.0±16.2	=0.01
S4	26.3±12.4	44.3±14.3	=0.01	26.1±12.1	27.6 ±9.3	=0.8
S5	25.8±9.1	24.4±13.1	=0.8	23.1 ±10.4	24.9± 8.1	=0.5
S6	41.8±13.2	43.5±13.1	=0.9	38.8 ±12.6	53.1± 14.4	=0.003
G	39.6±6.5	45.6±5.7	=0.005	35.8±5.4	46.9±7.8	=0.003
Mean increase in global EF			15%	Mean increase in global EF		30.5%

S: Segment, G: Global

is to restore normal LV diastolic volume and systolic function and to recover LV function by excising the scarred and noncontractile myocardial tissue [6]. Kitamura [15] reported a reduction in LVEDV (left ventricular end-diastolic volume), wall tension and LVEDP (left ventricular end-diastolic pressure), and an increase in EF after aneurysmectomy. In a series of 70 endoaneurysmorraphy patients, Krajcer and associates [16] reported a mean increase of 10.9% in the ejection fraction, postoperatively. In a series of 90 patients, there was a mean increase of 17% in the global EF in the endocircularplasty group versus a 10% increase in the classical aneurysmectomy group [17]. In the present study, preop global EF in the endoaneurysmorraphy group was significantly lower than those of the classical aneurysmectomy group. On the other hand, although it was not significant, the global EF increase (44.0%) in the endoaneurysmorraphy group was higher than that (33.3%) of the classical aneurysmectomy group after surgery. There are ongoing studies that evaluate the hemodynamic changes during exercise after surgery for LV aneurysm. Balu and associates [18] reported that the exercise tolerance was doubled after surgery for LV aneurysm. At 8 month follow-up, Stephens [19] indicated that cardiac index and the SVI did not change during exercise but LVEDP decreased both at rest and during exercise, postoperatively. However, Dymond and associates [20] could not demonstrate any change in EF during exercise after surgery for LV aneurysm. In our study, patients treated by classical or endoaneurysmorraphy techniques were assesed at rest and during exercise by MUGA postoperatively. During exercise the mean increases global EFs were 15.0% and 30.5% in the classical aneurysmectomy and endoaneurysmorraphy groups, respectively (table 3).

If it is taken into consideration that all the patients had LAD coronary artery revascularization and patent LIMA graft in classical aneurysmectomy group, inadequate response of anterior segment during dobutamine stress test may be due to resection of the aneurysm wall, longitudinal teflon strips used for closing of the ventriculotomy and/or amputation of the distal LAD. In group 2, the best response to dobutamin stress test was detected in the segments perfused by LAD coronary artery.

Besides above mentioned positive messages regarding classical and endoaneurysmorraphy techniques, there are some limitations in our study. The first one is related to dobutamine stress test in the preoperative period. The patients were not stressed to a level to prevent possible ischemic complications related to adrenergic stimulation. Secondly, if we could enroll more patients in our study, some differences in the study were expected to reach statistical significance. Lastly, during dobutamine stress test, the increase of LV ejection fraction in patients with classic aneurysmectomy may be attributed to the small and well-bordered aneurysms.

In conclusion, our findings support that, in the late postop period, in patients who underwent classic aneurysmectomy or endoaneurysmorraphy, left ventricular global and segmental ejection fractions increase during peak dobutamine stress test. Despite the fact that the endoaneurysmorraphy group has an poorer LV function than that of classic aneurysmectomy in the preoperative period, the results in patients with endoaneurysmorraphy were found to be as good as that of patient with classic aneurysmectomy.

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