

Absent Long-Term Benefit of Patch Versus Linear Reconstruction in Left Ventricular Aneurysm Surgery

Ruediger Lange, MD, Thomas Guenther, MD, Norbert Augustin, MD, Christian Noebauer, MD, Michael Wottke, MD, Raymonde Busch, MS, Norbert Mayr, MD, Hans Meisner, MD, and Klaus Holper, MD

Department of Cardiovascular Surgery, German Heart Center, Clinic at the Technical University, and Institute of Medical Statistics and Epidemiology, Technical University, Munich, Germany

Background. Endoventricular patch reconstruction of the left ventricle is considered the gold standard in surgery for left ventricular aneurysms, because of improved preservation of ventricular geometry. However, the superiority over conventional linear closure has not been demonstrated, as assessed by the long-term outcome.

Methods. Two hundred patients (66%) underwent linear closure (group L) and 105 patients (34%) had endoventricular patch reconstruction (group D) using the Dor technique. Linear closure has been performed since 1974 and from 1985 on the Dor technique has been applied as an alternative procedure. Both patient groups differed regarding age, sex distribution, site of infarction, and indication for surgery. Prior to the operation, 71% of the patients were in New York Heart Association (NYHA) class III or IV and mean ejection fraction was $34\% \pm 12\%$. Follow-up extends up to 25 years, with a cumulative total of 2,605 patient years.

Results. Early mortality was 6.5% in group L vs 5.7% in

group D (not significant [NS]). Actuarial survival after 10 years was $56 \pm 3.2\%$, with no difference between groups. Freedom from reoperation after 10 years was 95.6% in group L vs 95.2% in group D (NS). Preoperative risk factors for late mortality were age, left ventricular end-diastolic volume index and concomitant mitral valve surgery. The type of procedure and the date of operation had no influence on mortality. To date, 63% of the survivors are in NYHA class I and II.

Conclusions. In regard to long-term survival, rate of reoperation, and postoperative NYHA functional class, no benefit could be demonstrated when linear closure was compared with ventricular patch reconstruction for LV aneurysm repair. Hence, the technique of ventricular reconstruction may not be as important as previously thought, and at least for small aneurysms the simple and time sparing technique of linear closure may still be considered.

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Since the first resection of left ventricular aneurysm (LVA) reported in 1958 by Cooley and colleagues [1], various surgical techniques of LVA repair have been introduced with the aim of restoring left ventricular geometry in an effort to improve results [2, 3]. With all these techniques (conventional linear closure, endoventricular patch plasty, or endoaneurysmorrhaphy) a significant improvement in functional status can be achieved [4–8]. The impact of surgical technique on long-term results is discussed controversially. Some authors found no influence of surgical technique on operative mortality, long-term survival [9], and even functional and hemodynamic improvement [7, 9, 10]. Others could identify a lower hospital mortality and a better

functional improvement in patients with endoventricular patch plasty [8, 9]. To determine the efficacy of LVA resection with different surgical techniques we retrospectively analyzed 305 patients with postinfarction LVA operated at our institution. The aim of the current study was to evaluate clinical results, to analyze operative and long-term survival, and to identify factors predicting operative mortality.

Material and Methods

We retrospectively analyzed 305 consecutive patients with LVA operated on between May 1974 and December 2000 at the German Heart Center Munich. In 200 of these (66%), linear resection with standard closure, as described by Cooley and colleagues, was performed (group L) [11]. One hundred and five (34%) patients underwent aneurysmectomy with endoventricular patch repair according to the technique described by Dor and colleagues [group D] (2). Linear closure has been performed since 1974 and the Dor technique was added as an

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Address reprint requests to Prof Dr Lange, Klinik für Herz- und Gefäßchirurgie, Deutsches Herzzentrum, Klinik an der Technischen Universität München, Lazarettstraße 36, D-80636 München, Germany; e-mail: lange@dhhm.mhn.de.

Table 1. Preoperative Clinical Data in 305 Patients With LV Aneurysm

Variable	Group L (n = 200)	Group D (n = 105)	p Value
Age (mean $\pm$ SD) [years]	54.5 $\pm$ 8.6	62 $\pm$ 9.5	0.001
Sex (f/m) (%)	13/87	24/76	0.02
Delay from MI [years]	2.2 $\pm$ 3.1	3.8 $\pm$ 5.9	
NYHA functional class [%]			NS
Class I	0	1	
Class II	12	21	
Class III	48	43	
Class IV	24	26	
Unclear	16	9	
Mean NYHA class	3.1 $\pm$ 0.6	3.0 $\pm$ 0.8	
Site of infarction [%]			0.01
Anterior	91	79	
Posterior	5.5	11	
Anterior + posterior	3.5	6	
Unclear		4	
Ventricular tachycardia/fibrillation [%]	16.5	22	NS
Coronary artery disease [%]			NS
Left main stenosis	6	8	
Triple vessel	36.5	33	
Double vessel	32	32	
Single vessel	23	24	
Unclear	2.5	2	
Indications for operation [%]			0.04
Angina pectoris	42	31	
Congestive heart failure	24	40	
Arrhythmia	7	6	
Combination of symptoms	12.5	10	
Unclear	14.5	13	

MI = myocardial infarction; NYHA = New York Heart Association; NS = not significant.

alternative procedure in 1985. All operations were performed by a total of six surgeons. The two surgical techniques were used depending on the personal preference of each surgeon.

All patients had preoperative coronary angiography and left ventriculography an average 3.9 ± 4.0 months before the operation. Clinical symptoms, hemodynamic data, functional outcome, and survival rate were analyzed from medical records, patients follow-up visits, and communications from the referring physicians. In 78 (25.6%) patients, cardiac performance was assessed postoperatively by ventriculography. Congestive heart failure (CHF) was defined according to New York Heart Association (NYHA) functional class. The average age of the patients was 57 ± 9.6 years (range, 26.3 to 79.7 years). One hundred and twenty-six patients (41%) were older than 60 years. Two hundred and fifty-three (83%) were men and 52 (17%) were women [5:1]. Single indications for operation were angina in 38%, CHF in 30%, and severe rhythm disturbances in 7%. Eleven percent of the patients presented with a combination of symptoms. Congestive heart failure (40%) was the most frequent indica-

Table 2. Preoperative Hemodynamic Data

Variable	Group L (n = 200)	Group D (n = 105)	p Value
	Mean $\pm$ SD	Mean $\pm$ SD	
RAP (mm Hg)	5.3 $\pm$ 2.8	5.1 $\pm$ 3.3	
LAP (mm Hg)	15.8 $\pm$ 8.2	16.8 $\pm$ 7.9	
RV (sys) (mm Hg)	39.3 $\pm$ 15.1	40.8 $\pm$ 14.9	
RVEDP (mm Hg)	7.7 $\pm$ 3.6	6.7 $\pm$ 3.7	
LV (sys) (mm Hg)	121.5 $\pm$ 24.0	125.7 $\pm$ 21.4	
LVEDP (mm Hg)	21.4 $\pm$ 11.2	20.5 $\pm$ 9.3	NS
PAP mean (mm Hg)	25.1 $\pm$ 10.8	25.5 $\pm$ 9.7	
AO (mean) (mm Hg)	90.9 $\pm$ 14.4	89.8 $\pm$ 14.4	
EDVI (mL/m ²)	133 $\pm$ 49.2	146.3 $\pm$ 40.8	0.031
ESVI (mL/m ²)	92.2 $\pm$ 50.7	102.7 $\pm$ 34.5	0.01
EF (%)	35.1 $\pm$ 12.8	32.7 $\pm$ 10.9	NS

Preoperative cardiac catheterization data of 305 patients who underwent aneurysmectomy with different surgical techniques.

AO mean = mean aortic pressure; EDVI = enddiastolic volume index; EF = ejection fraction; ESVI = endsystolic volume index; LAP = left atrial pressure; LV (sys) = left ventricular systolic pressure; LVEDP = left ventricular enddiastolic pressure; NS = not significant; PAP mean = mean pulmonary artery pressure; RAP = right atrial pressure; RV (sys) = right ventricular systolic pressure; RVEDP = right ventricular enddiastolic pressure; SD = standard deviation.

tion for surgery in group D, while angina (42%) was the most frequent in group L ($p = 0.04$). The site of infarction was anteroapical in 87% of the patients and posterior in 7.5%. Anteroapical infarction was more frequent in group L compared with group D (91% vs 79%); posterior infarction was more frequent in group D (11% vs 5.5%) ($p = 0.01$). The average interval between preoperative infarction and operation was 2.7 ± 4.3 years. Seven percent of the patients presented with left main disease, 23% had single-vessel disease, 32% had two-vessel disease, and 35% had three-vessel disease. Fifty-six patients (18%) had an incidence of sustained ventricular tachycardia or fibrillation preoperatively. Twenty-nine patients (9.5%) had undergone cardiopulmonary resuscitation. Seventy-one percent of the patients were in NYHA functional class III or IV. Diabetes mellitus was present in 18% of the patients, lipid abnormalities in 50%, hypertension in 39%, and a history of smoking in 39%. Preoperative clinical and hemodynamic data of the study groups are summarized in Table 1 and Table 2, respectively.

Operative Technique

All operations were performed on cardiopulmonary bypass and moderate systemic hypothermia (26 to 32°C). Cold crystalloid cardioplegia (Bretschneider solution) was used in 107 patients (35%) [12]. The remaining patients were operated with the heart arrested by hypothermic fibrillation without aortic clamping. In cases with concomitant bypass grafting, the distal anastomoses were performed first. Then the left ventricular aneurysm was opened and resection of the endocardial scar was performed. In the cases with linear closure, the edges of the aneurysm were closed over two Teflon felt strips using a continuous horizontal mattress-suture reinforced

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