

SURGICAL VENTRICULAR RESTAURATION FOR LEFT VENTRICULAR ANEURYSM AFTER MIOCARDIAL INFARCTION

PhD: Bălău Radu Alexandru

PhD Coordinator: Prof. Dr. Deac Radu

Background: The consequence of transmural myocardial infarction in the absence of early revascularization is ventricular remodeling defined by ventricular outgrowth distortion due to left ventricular aneurysm (LVA) development and ventricular dilation resulting in left ventricle (LV) sistolo-diastolic dysfunction and cardiac failure. The current objectives of surgical reconstruction of LV are reduction of ventricular volumes, recreation of a geometry as close as possible to the original and correction of myocardial ischemia by revascularization. After more than half a century after the first report of a surgical correction for the LVA, many controversies about the best correction technique still remain, the data published in the literature failing to provide a clear answer to this issue.

Objective: The purpose of this research was to evaluate the evolution of patients who benefited from surgical LV reconstruction (SVR) for the LVA after acute myocardial infarction (MI) between 2007-2014 in the Cardiovascular Surgery Clinic from Tirgu Mures. In this respect, two studies were conducted. Two studies were conducted to achieve this goal. The first study aimed to determine the short- and medium-term results in terms of mortality, morbidity and functional recovery of patients both globally across the study group and divided into two categories of surgical techniques used for correction aneurysmal pathology. The second study was a echocardiographic one and followed the evaluation by repeated echocardiographic examinations of structural and functional changes of the left ventricle, comparatively, on the two categories of surgical techniques.

Method: The study group was represented by 117 consecutive patients, 86 males (73.5%) and 31 women (26.5%) with a history of transmural myocardial infarction (MI), LV systolic and diastolic dysfunction and LV dyskinetic or akinetic aneurysm. Diagnosis and indication for surgery was based on clinical symptoms (NYHA class, angina class), echocardiographic and angiocoronarographic examinations. Clinical study analyzed intraoperative aspects, early and late morbidity and mortality from a mean follow-up of $5,7 \pm 3,1$ years. Echocardiographic study was performed by repeated examinations, preoperative, at discharge, 1 year and 3 years after surgery.

Results: In 25 of the patients, the study was not completed due to death or loss in follow-up. Thus, the study was complete for 92 patients (79%).

Intraoperative aspects: In 48 patients (41%) correction was performed using double elliptic intraventricular patch, and in 69 patients (59%) linear correction was performed. The mean aortic clamp time was 80.24 ± 28.1 minutes for group I and 68.9 ± 26.6 minutes for group II ($p = 0.03$). Average cardiopulmonary bypass was 148.8 ± 56.4 minutes for group I and 127.7 ± 41.3 minutes for group II ($p = 0.02$). Surgical myocardial revascularization was performed in 108 patients (92.3%), 42 in group I (87.5%) and 66 in group II (95.7%), with an average number of grafts per patient of 2.1 ± 0.54 (1.73 ± 0.44 in patch group and 2.36 ± 0.65 in linear group, $p = 0.001$). Left internal mammary artery was used in 41 patients (35.0%), 14 from group I (29.2%) and 27 from group II (39.1%). The intraventricular thrombus extraction was performed in 21 (18.0%) patients, 14 (29.2%) from group I and 7 (10.1%) from group II ($p = 0.01$). Mitral valve plasty was performed in 18 patients (33.7%), 12 (25.0%) from group I and 6 (8.7%) from group II ($p = 0.02$). The closure of VSD was performed in 8 patients (6.8%), 4 in each group. Mitral valve replacement was performed in 4 patients (3.4%) all from linear group. Tricuspid valve plasty was performed in 3 (2.6%) patients and 2 patients (1.7%) benefited from aortic valve replacement for associated severe aortic stenosis. Associated carotid endarterectomy was performed in 5 patients, all from group II.

Immediate results: Intraoperative mortality was 1.7% (2 patients), one in each group, both due to irreducible left ventricular insufficiency, which determined the impossibility of suppressing the cardiopulmonary bypass. Total perioperative mortality (intraoperatively or in the first 30 days postoperatively) was 11.11% (13 patients), 1 (2.1%) of group I and 10 (14.4%) of group II $p = 0.05$. The cause of death was low cardiac output in 7 (6%) patients, ventricular arrhythmias in 4 patients (3.4%) and MSOF in 2 (1.7%) cases.

Twenty-three patients (20.0%) had postoperative low cardiac output, of whom 17 (14.8%) needed circulatory support with IABP. Eleven patients (9.6%) had ventricular arrhythmias (nonsustained ventricular tachycardia, ventricular extrasystoles), and 49 patients (42.6%) had supraventricular arrhythmias (atrial

fibrillation, supraventricular tachycardia, atrial extrasistoles). Ten of the patients (8.7%) developed post-operative acute renal failure requiring hemodialysis sessions. Six of the patients (5.2%) needed surgical reexploration for post-operative bleeding. Eight patients (6.9%) developed respiratory failure, 3 patients (2.6%) had gastrointestinal haemorrhage, and 2 patients (1.7%) had haemorrhagic stroke. Low cardiac output and ventricular arrhythmias have occurred in greater proportion in linear group ($p < 0.05$). One hundred and three patients (89.5%) required inotropic and / or vasopressor support for at least 24 hours, dopamine, dobutamine and adrenaline being the most commonly used drugs, with no significant difference between groups. The average inotropic support time was 4 days. The average number of days spent in the ICU was 4, and the mean postoperative hospitalization was 11 days, with a longer stay for patients from group II ($p = 0.03$).

Late results: The mean follow-up time was 5.7 ± 3.1 years without differences between groups. During follow-up there were 13 deaths, 3 in the first and 10 in the second lot, so at the end of the study the number of alive patients was 83 (70.94%), with a statistically significant difference between the two groups- 88.9% in patch group and 67.2% in linear group ($p = 0.009$). Ventricular arrhythmias were the main cause of death during follow-up (5 patients), followed by heart failure (3 patients) and myocardial infarction (2 patients), while 3 patients died of non-cardiac causes.

During follow-up, the main complication was the ventricular arrhythmias, which occurred in 18 patients (18.75%), 11 (25.6%) from group I and 7 (13.2%) from group II ($p = 0.072$) which required implantation of ICD in 7 patients (7.3%). Third-degree mitral regurgitation was found in 7 patients (7.3%), and remaining PAH in 5 patients (5.2%). Four patients (4.2%) required coronary stenting for new stenosis and recurrent angina. Three patients (3.1%) had digestive bleeding by dicumarin overdose, 3 patients (3.1%) suffered ischemic stroke, and one patient was successfully reoperated for acute aortic dissection Stanford A type, 7 years after the first intervention. In total, 23 patients (24%) needed readmission during follow-up. There were no differences between the two groups regarding complications recorded during follow-up.

There was a great improvement in NYHA functional class after surgery. If in the preoperative phase 86 (73.5%) of the patients were in NYHA III / IV classes, at the last control, only 11 (11, 5%) of the 96 patients completing the follow-up were NYHA class III without group differences.

Global survival rates at 1, 5 and 10 years were 85.8%, 78.5% and 76.7%, respectively, with better survival rate in group I (93.3%, 88.7% and 86.6% in group I, vs. 80.3 %, 71.2% and 68.3% in group II). The estimated mean survival was 8.8 years for group I and 7.2 years for lot 2, $p = 0.03$

Echocardiographic results: In lot I there was an increase in left ventricular ejection fraction (LVEF) from $33.98 \pm 6.36\%$ preoperatively to $40.54 \pm 5.71\%$ at the 3 years echocardiographic examination ($P < 0.0001$), while LVEF in group II increased from $37.45 \pm 6.09\%$ preoperatively to $40.65 \pm 6.59\%$ at the 3-year examination ($P < 0.01$).

In group I, left ventricular end diastolic volume index (LVEDVI) decreased from $121.5 \pm 33.23 \text{ ml/m}^2$ preoperatively to $80.27 \pm 26.74 \text{ ml/m}^2$ at 3 years after the surgery ($p = 0.0001$). In group II, LVEDVI decreased from $98.86 \pm 20.58 \text{ ml/m}^2$ preoperatively to $79.38 \pm 19.49 \text{ ml/m}^2$ at 3 years after the surgery ($p = 0.0001$).

In group I, left ventricular end systolic volume index (LVESVI) decreased from $79.56 \pm 27.33 \text{ ml/m}^2$ preoperatively to $49.8 \pm 20.05 \text{ ml/m}^2$ at 3 years after the surgery ($p = 0.0001$). In group II, LVESVI decreased from $98.86 \pm 20.58 \text{ ml/m}^2$ preoperatively to $79.38 \pm 19.49 \text{ ml/m}^2$ at 3 years after the surgery ($p = 0.0001$).

Conclusions: SVR is a procedure performed for correction of ischemic LVA with good early and medium-term results. The correction technique must be individualized for each patient, and the choice of one or another type of procedure should take into account in particular the location and size of the aneurysm as well as the estimated dimensions of the remaining ventricular cavity. Large aneurysms, with antero-lateral localization, benefited from RGVS with an elliptical patch, while small aneurysms with posterior or basal localization benefited from incision and linear suture.

The results of this study showed that endoventricular reconstruction with elliptic patch had better results than linear correction regarding early and late mortality and morbidity, LVEF, LV volumes and NYHA functional class improvement.

Concomitant surgical revascularization and mitral insufficiency procedures (especially valvuloplasty procedures) contributes to the good results.

The long-term prognosis of patients who underwent SVR is strongly influenced by the development of cardiomyopathy and its complications (ventricular arrhythmias, mitral regurgitation through cavity dilation, pulmonary hypertension) and by the evolution of coronary artery disease, the main determinant of pathology.

