

## Influence of Left Ventricular Systolic Dysfunction on Results of Mitral Valve Reconstruction in Patients with Mitral Regurgitation

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This research was based on the data of 218 patients with mitral valve regurgitation, who received surgical treatment at National M.M. Amosov Institute of Cardiovascular Surgery National Academy of Medical Sciences of Ukraine from 01.01.2010 to 01.01.2015 years. The average age of patients was  $52, 8 \pm 13,0$  years (16,0-78,0). In postoperative period signs of heart failure (HF) were diagnosed in 43 (19.7%) cases. Hospital mortality was 2.3%. Comparative analysis of clinical data between subgroups of hemodynamically stable patients and patients HF and in postoperative period was performed. Left ventricular (LV) systolic dysfunction in patients with mitral regurgitation (MR) determined the risk of HF in the early postoperative period and adverse outcome. In patients with MR initial decrease of left ventricular ejection fraction (LVEF) to 50% was associated with adverse surgical treatment outcome.

**Key words:** left ventricular systolic dysfunction, mitral regurgitation, comparative analysis.

Diminished left ventricular contractility adversely affect the survival of patients with MR after isolated medical treatment and surgery. Despite of numerous studies a number of questions remain open: the borderline of the left ventricular (LV) dysfunction in MR, the indications for surgical treatment, choice of surgical correction method.

MR is one of the leading valvular heart diseases, which ranks second in the structure of valve defects after aortic stenosis. Volume overload of left ventricle due to MR eventually leads to disruption of myocardial contractility, pulmonary hypertension and right ventricular dysfunction.

Some researches show that ejection fraction less than 60% and end-systolic dimension (ESD) of LV more than 40 mm are associated with increased mortality in the cases of isolated medical treatment and surgery [1, 7]. Other studies reveal that prognostic mortality risk factors in patients with MR are: clinical manifestations, age, atrial fibrillation, increased volume of MR (effective regurgitation area  $\geq 40$  cm<sup>2</sup>), left atrial dilatation, dilation of the left ventricle (LV ESD  $> 45$  mm) and reduced ejection fraction (EF) of LV less 50% [2, 3].

Left ventricular dysfunction carries a worse prognosis and the risk of surgery is higher. Surgery is recommended even in the absence of symptoms or LV dysfunction. In patients with severe left ventricular dysfunction (ejection fraction  $< 35\%$ ) both data – hospital mortality (8%) and 5-year survival rate (54%) – were significantly worse than in groups of patients with preserved LV function – 2% and 82% respectively [4].

It is noted that degree of LV dysfunction increases progressively in postoperative period if the initial LVEF was less 40% [9]. Borderline of LV dysfunction, when mitral correction is still recommended, include LVEF = 30% and LV ESD = 55 mm [5, 6].

Assessment of surgical correction methods in MR shows that mitral repair compared to mitral replacement is associated with better immediate and remote survival. The prevalence of mitral reconstruction is confirmed by the following facts. First, after mitral repair the chordal-papillary apparatus remains fully preserved, that determine the left ventricular contraction. Second, after mitral repair there are no complications directly related to an implanted mechanical/bioprosthetic heart valve (dysfunction of the prosthesis, prosthetic IE). Thirdly, the anticoagulation therapy is determined only in the presence of atrial fibrillation, and not by the fact of implanted prosthesis. According to this the incidence of anticoagulant related complications is reduced.

**Objective:** study the influence of LV systolic dysfunction on the postoperative course and outcome of surgical treatment in patients who underwent mitral valve reconstruction.

**Materials and methods.** The research is based on the data of 218 patients with mitral valve regurgitation, who received surgical treatment at National M.M. Amosov Institute of Cardiovascular Surgery National Academy of Medical Sciences of Ukraine from 01.01.2010 to 01.01.2015 years. The average age of patients was  $52, 8 \pm 13,0$  years (16,0-78,0). The gender ratio of men to women – 151 (69.3%) and 67 (30.7%), respectively. Patients with postinfarction mitral valve regurgitation were not included in the study. Acute MR was noted in 10 (4.6%) cases. The causes for MR were: myxomatous degeneration – 130 (59.6%) cases, chordal-papillary dysplasia of mitral valve – 44 (20, 2%) cases, infective endocarditis – 19 (8.7%) cases, secondary MR due to myocardial pathology – 25 (11.5%) cases. According to A. Carpentier classification following types of MR were identified: I type – 19 (8.7%) cases, II type – 174 (79.8%) cases, III type – 25 (11.5%)

cases. Hemodynamically significant coronary arteries disease was found in 11 (5.0%) patients. Preoperatively distribution of patients by NYHA functional classes(FC) was as follows: I-II FC – 142 (65,1%), III FC – 73 (33,5%), IV FC – 3 (1.4%) cases. Signs of congestive heart failure (IIb degree) were registered in 75% of cases.

Surgical tactics and intraoperative management were carried out according to the protocol adopted at National M.M. Amosov Institute of Cardiovascular Surgery National Academy of Medical Sciences of Ukraine. Related surgery included: tricuspid valve repair – 199 (91.3%), CABG – 11 (5.0%), MAZE procedure – 6 (2.8%), left atrial reduction plasty – 3 (1.4%), epicardial electrode implantation – 9 (4.1%) and pacemaker implantation – 5 (2.3%) cases respectively. The average duration of aorta cross clamp and cardiopulmonary bypass time were  $111,3 \pm 37,1$  min. and  $177,0 \pm 41,7$  min. respectively.

Statview software was used for statistical analysis. The Student's t-test was performed to compare independent variables. Differences of categorical variables were assessed by means of chisquare test or Pearson's exact test.

In order to identify risk factors for adverse postoperative outcome clinical data obtained during preoperative examination were used as independent variables. As dependent variable, in the first case, a mode of postoperative period (absence or presence of heart failure) was used. Heart failure (HF) was defined as a state of decline in systolic blood pressure less than 90 mmHg (or reduction in systolic blood pressure of 40 mmHg below initial operating pressure, which requires use of sympathomimetic drugs after an optimal preload and correction of electrolyte disturbances and blood gases). In the second case, as dependent variable result of surgery was selected (mortality rate).

**Results.** In the postoperative period signs of HF were registered in 43 (19.7%) cases. Overall hospital mortality was 2.3% (5 deaths in 218 surgeries).

At first the comparative analysis of clinical data between subgroups of patients with or without HF in postoperative period was performed. Subgroups of patients who had HF were characterized by increased end diastolic volume index(EDI)–  $114,3 \pm 40,2$  ml / m<sup>2</sup> (p = 0.046) and end systolic volume index(ESI) –  $66,8 \pm 40,0$  ml / m<sup>2</sup> (p = 0.001), lower stroke index(SI) –  $53,1 \pm 18,9$  ml / m<sup>2</sup> and left ventricular ejection fraction –  $47,7 \pm 16,7\%$  (r<0,001), increase of right ventricle systolic pressure –  $51,6 \pm 13,3$  mmHg (p=0.016). In addition, in that group type III of MR by Carpentier was identified in 12 (27.9%) cases (r<0,001) and signs of left bundle branch block in 15 (34.9%) cases (r<0.001). Analysis of intraoperative data was characterized by longer duration of aortic cross clamp and cardiopulmonary bypass –  $119,3 \pm 24,6$  min. (p = 0.030) and  $190,9 \pm 43$  min. (p = 0.015) respectively. Early postoperative period was characterized by high doses of dobutamine –  $4,0 \pm 1,2$  mcg / kg / min. (R<0,001) and norepinephrine –  $0,1 \pm 0,05$  mg / kg / min. (p = 0.009) and a longer period of sympathomimetic therapy. Group of patients with HF was characterized with high frequency of lethal cases- 3 (7%) (p = 0.022). Borderline of left ventricular ejection fraction in this study was 53.2% (Tab. 1, Tab. 2).

Similarly, after mitral valve reconstruction comparative analysis between the subgroups of patients, in-hospital death group and recovered group, was performed. The subgroup of patients (in-hospital death group) was characterized by increased EDI –  $134 \pm 33,5$  ml / mI (p = 0,042) and ESI –  $87,4 \pm 28,1$  ml / m<sup>2</sup> (p = 0.022), lower SI –  $44,5 \pm 3,5$  ml / m<sup>2</sup> (p = 0.243) and left ventricular ejection fraction –  $43,2 \pm 11,9\%$  (p = 0.026), increased right ventricular systolic pressure –  $65,0 \pm 7,1$  mm Hg. (P = 0.003). In this group more often type III of MR by Carpentier- 2 (40%) cases (p = 0.067) and left bundle branch block – 3 (60%) (p = 0.006) were registered. Intraoperative data analysis showed a tendency to longer duration of cardiopulmonary bypass –

**Table 1**

*Comparative analysis of quantitative clinical characteristics between subgroups of patients, depending on the absence or presence of HF*

Data	M HF "absent" group (n=175)		M HF "present" group (n=43)		t	p	Border-line
		SD		SD			
EDI, ml/m <sup>2</sup>	103,5	29,1	114,3	40,9	-2,0	0,046	108,9
ESI, ml/m <sup>2</sup>	44,9	25,0	66,8	40,0	-4,1	0,000	55,9
SI, ml/m <sup>2</sup>	61,3	18,2	53,1	18,9	2,3	0,020	57,2
LVEF, %	58,7	11,8	47,7	16,7	4,9	0,000	53,2
Right ventricular systolic pressure, mmHg	45,9	14,0	51,6	13,3	-2,4	0,016	48,7
Aortic clamp time, min.	109,3	27,4	119,3	24,6	-2,1	0,030	114,3
Bypass time, min	173,6	40,7	190,9	43,2	-2,4	0,015	182,3
Dobutamine, mcg/kg/min	1,9	1,1	4,0	1,2	-11,2	0,001	2,9
Norepinephrine, mcg/kg/min	0	0	0,1	0,5	-2,6	0,009	0,05

**Table 2**

Comparative analysis of qualitative clinical characteristics between subgroups of patients, depending on the absence or presence of HF

Data		HF "absent"		HF "present"		X <sup>2</sup>	p
		n	%	n	%		
Left bundle branch block	absent	149	85,6	26	63,4	16,2	0,001
	incomplete	19	10,9	7	17,1		
	complete	6	3,5	8	19,5		
MR type by Carpentier	I type	16	9,1	3	7,0	14,2	0,000
	II type	146	83,5	28	65,1		
	III type	13	7,4	12	27,9		
Mortality	absent	173	98,9	40	93,0	5,2	0,022
	present	2	1,1	3	7,0		

**Table 3**

Comparative analysis of quantitative clinical characteristics in sub-groups of patients depending on the outcome of surgical treatment

Data	M Recovered group (n=213)	SD	M In-hospital death group (n=5)	SD	t	p	Borderline
EDI, ml/m <sup>2</sup>	105,0	31,7	134,3	33,5	-2,0	0,042	119,6
ESI, ml/m <sup>2</sup>	48,3	29,2	87,4	28,1	-2,3	0,022	67,8
SI, ml/m <sup>2</sup>	60,0	18,6	44,5	3,5	1,2	0,243	52,2
LVEF, %	56,8	13,5	43,2	11,9	2,2	0,026	50,0
Right ventricular systolic pressure, mmHg	46,6	13,9	65	7,1	-2,9	0,003	55,8
Bypass time, min	176,3	41,5	208,4	41,2	-1,7	0,089	192,3
Dobutamine, mcg/kg/min	2,2	1,4	3,8	1,7	-2,5	0,014	3,0

**Table 4**

Comparative analysis of qualitative clinical characteristics in sub-groups of patients depending on the outcome of surgical treatment

Data		Recovered group		In-hospital death group		X <sup>2</sup>	P
		n	%	n	%		
Left bundle branch block	absent	173	82,4	2	40,0	10,1	0,006
	incomplete	25	11,9	1	20,0		
	complete	12	5,7	2	40,0		
MR type by Carpentier	I type	18	8,4	1	20,0	5,4	0,067
	II type	172	80,8	2	40,0		
	III type	23	10,8	2	40,0		

208,4 ± 41,2 min. (p = 0.089). Early postoperative period was characterized by high doses of dobutamine – 3,8 ± 1,7 mcg / kg / min. (p = 0.014). Borderline LVEF in this analysis was 50.0% (Tab. 3, Tab. 4).

Thus, application of the same type of comparative analysis shows that, replacement of the dependent variable from the

mode of postoperative period (absence or presence of HF) to the result of surgery (recovered – in-hospital death) reveals tendency to increased EDI and ESI (cardiomegaly), decreased SI, reduced left ventricular ejection fraction (LV systolic dysfunction) and increased RV systolic pressure (hypertension in the pulmonary circulation). At this point borderline of LVEF shifts from 53.2% to 50.0%. These data show that preoperative LVEF within 53-50% is associated with adverse postoperative period and risk of lethal outcome.

#### Conclusions

1. LV systolic dysfunction in MR determines the risk of HF in early postoperative period and adverse surgical treatment outcome.
2. For patients with MR initial reduction of LVEF to 50% is associated with adverse surgical treatment outcome.

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### **Вплив систолічної дисфункції лівого шлуночка на результати реконструкції мітрального клапана у хворих з мітральною недостатністю**

Лучинець О. Ф.

Дане дослідження ґрунтується на вивченні 218 пацієнтів з недостатністю мітрального клапана, які перебували

на хірургічному лікуванні в ДУ «Національний інститут серцево-судинної хірургії імені М. М. Амосова НАМН» з 01.01.2010 по 01.01.2015 рр. Середній вік пацієнтів склав  $52,8 \pm 13,0$  років (16,0–78,0). В післяопераційному періоді ознаки гострої серцевої недостатності (ГСН) реєструвались у 43 (19,7%) випадках. Госпітальна летальність склала 2,3%. Проведено порівняльний аналіз клінічних характеристик між підгрупами хворих, у яких були відсутні або реєструвались ознаки ГСН у післяопераційному періоді. Систолична дисфункція лівого шлуночка (ЛШ) при мітральній недостатності (МН) визначає ризик розвитку ГСН у ранньому післяопераційному періоді та несприятливий наслідок хірургічного лікування. Для хворих з МН вихідне зниження ФВ до 50% поєднується з несприятливим перебігом хірургічного лікування.

*Ключові слова:* систолічна дисфункція лівого шлуночка, мітральна недостатність, порівняльний аналіз.

### **Influence of left ventricular diastolic dysfunction on results after reconstruction mitral valve surgery in patients with mitral regurgitation**

Лучинець А. Ф.

Данное исследование основывается на изучении 218 пациентов с недостаточностью митрального клапана, находившихся на хирургическом лечении в ГУ «Национальный институт сердечно-сосудистой хирургии имени Н. М. Амосова НАМН» с 01.01.2010 по 01.01.2015 гг. Средний возраст пациентов составлял  $52,8 \pm 13,0$  лет (16,0–78,0). В послеоперационном периоде признаки острой сердечной недостаточности (ОСН) регистрировались в 43 (19,7%) случаях. Госпитальная летальность составила 2,3%. Проведен сравнительный анализ клинических характеристик в подгруппах больных, у которых отсутствовали или регистрировались признаки ОСН в послеоперационном периоде. Систолическая дисфункция левого желудочка (ЛЖ) при митральной недостаточности (МН) определяет риск развития ОСН в раннем послеоперационном периоде и неблагоприятный исход хирургического лечения. Для больных с МН исходное снижение ФВ до 50% сочетается с неблагоприятным течением хирургического лечения.

*Ключевые слова:* систолическая дисфункция левого желудочка, митральная недостаточность, сравнительный анализ.