

Local Myocardial Contractility of the Left Ventricle in Patients with Ischaemic Heart Disease After Revascularisation

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Annotation:

Ischaemic heart disease is a major cause of morbidity and mortality in a worldwide epidemic. Myocardial ischaemia is characterised by an imbalance between myocardial oxygen delivery and myocardial oxygen demand, causing cardiac dysfunction, arrhythmias, myocardial infarction and sudden death. Various clinical manifestations of ischaemia are due to obstruction of coronary blood flow due to coronary stenosis, thrombosis and hyperconstriction (vasospasm) of epicardial and microvascular coronary arteries

Key words: myocardial remodelling, revascularisation, aortocoronary bypass, percutaneous coronary intervention

Introduction. A multidimensional approach to management integrates all these considerations, often simultaneously, in every patient. Among pharmacotherapeutic agents, three classes of drugs have been demonstrated to reduce mortality and morbidity in patients with stable CHD and preserved left ventricular (LV) function: aspirin, angiotensin-converting enzyme (ACE) inhibition, and effective lipid lowering. Beta-blockers have been shown to reduce mortality in patients with incident MI [1,3,7]. Other therapies such as nitrates, beta-blockers, calcium channel blockers and ranolazine have been shown to improve angina and exercise capacity and reduce ischaemia, but have not been shown to reduce mortality in patients with stable CHD [11,18].

Clinical practice guidelines for the diagnosis and management of chronic stable angina, unstable angina/myocardial infarction without ST-segment elevation and ST-segment elevation myocardial infarction were published jointly by the American College of Cardiology (ACC) [2,4,8,12]. These guidelines detail the indications and timing of drug therapy (including lifestyle modification) and revascularisation with PCI (percutaneous coronary intervention) or ACS (aortocoronary artery bypass grafting), and provide recommendations for secondary prevention, including reduction of risk factors. Although revascularisation has specific indications, drug treatment, lifestyle modification and risk factor reduction are recommended for the entire spectrum of CHD in both stable and unstable patients and after a coronary event or revascularisation [5,7,9,12].

The most recent advance in medical therapy has been the advent of ranolazine. Non-pharmacological therapies include spinal cord stimulation and enhanced external counterpulsation (EECP) for the treatment of angina and ischaemia. Advances in revascularisation include the development of drug-coated stents, the introduction of percutaneous support devices in patients undergoing PCI and the

increased use of non-infused techniques, as well as minimal access and robotic procedures in patients undergoing ACS. Interest and experience are also growing in hybrid revascularisation procedures using a collaborative approach between interventional cardiologists and cardiothoracic surgeons [3,10,13,15].

Aim of the study: to investigate the peculiarities of local contractility of the left ventricular myocardium in CHD patients after revascularisation.

Materials and methods of the study: Data of 122 patients with coronary heart disease who were hospitalised in Samarkand regional branch of the Republican Scientific and Practical Centre of Cardiology were analysed during the study. The patients were divided into two groups depending on the method of myocardial revascularisation. The 1st group included patients who underwent aortocoronary bypass surgery (n = 54), the 2nd group included patients after coronary artery stenting (n = 68). Patients of both groups were comparable in age, frequency of MI in the history, severity of coronary lesions, myocardial contractile function, and the presence of concomitant pathology. The diagnosis of coronary disease was verified on the basis of anamnesis, complaints and confirmed by objective examination methods. Before and after the operation all patients underwent a complex of non-invasive investigations including standard electrocardiography, exercise test on a treadmill, ECG Holter monitoring, echocardiography, X-ray examination, as well as standard laboratory methods of examination.

Statistical processing of the data was carried out by parametric and nonparametric methods of statistical processing using the software package Statistica for Windows v. 6.0. The mean values were calculated

(M), standard error of mean (m), Student's t-criterion was used to compare the obtained data. The dynamics of the indicators was assessed using paired t-criterion. Comparative analysis of the frequency of signs was carried out using Pearson's χ^2 -criterion. Differences were considered reliable at $p \leq 0.05$. Differences between two dependent groups of observations (before and after surgery) by a quantitative sign having a distribution close to normal were evaluated using Student's t-criterion for dependent samples. The reliability of the influence of factors was assessed using Fisher's F-criterion.

Results of the study: It is known that patients who underwent myocardial revascularisation surgery, in most cases have impaired local contractility of LV myocardium. This is often due to the presence of scarring changes due to a previous MI, LV remodelling, and areas of viable 'hibernating' or 'stannous' LV myocardium[14,16,17].

Table 1.

Dynamics of local contractility impairment index (LRI) depending on the type of transmittal blood flow

Types of transmittal blood flow	Timing	Patients with ACS (n=54)	Patients with PCI (n=68)
'Rigid'	Before surgery	1,20±0,2	1,19±0,2
	After 3 days	1,24±0,2	1,21±0,2
	After 2 weeks	1,22±0,2	1,18±0,2

	After 1 month	1,21±0,7	1,16±0,2
'Pseudonormal'	Before surgery	1,33±0,4	1,21±0,2
	After 3 days	1,34±0,4	1,22±0,2
	After 2 weeks	1,31±0,4	1,18±0,2
	After 1 month	1,29±0,4	1,20±0,2
'Restrictive'	Before surgery	1,22±0,01	2,62±0,01
	After 3 days	1,22±0,01	2,81±0,01
	After 2 weeks	1,23±0,01	2,52±0,01
	After 1 month	1,21±0,01	2,51±0,01

As can be seen from Table 1, the most pronounced impairments of regional contractility of LV myocardium were observed in 'pseudonormal' (1.33±0.4 points) and 'restrictive' (2.62±0.01 points) types of transmittal blood flow, which reflects a direct relationship between the degree of impairment of regional contractility and the severity of diastolic dysfunction. There was no significant difference in INLS depending on the method of treatment at different severity of diastolic dysfunction ($p>0.05$). After ACS and PCI in 1 month the following dynamics of LV local contractility disorders occurred: 1. Disappearance of the zone of disturbed contractility, including complete restoration of initially disturbed segmental contractility - in 11 (20,3%) patients and 22 (32,3%) patients, respectively. 2. Appearance of a new zone of hypokinesia - in 4 (7,4%) and 8 (11,7%) patients. 3. Absence of hypokinesia zone, both preoperatively and after 1 month - in 20 (37%) and 28 (41.4%) patients. 4. Presence of local contractility disorders before and after the operation - in 15 (27,8%) and 10 (14,7%) patients, respectively.

Normalisation or relative increase of LV myocardial global contractility, which in its turn occurs due to restoration of contractility of 'hibernated' and 'stannulated' myocardium, is one of the expected results of IBS surgical treatment. The dynamics of ejection fraction in the early postoperative period according to our study is demonstrated in Table 2.

Table 2.

Ejection fraction dynamics before surgery and after 1 month in the comparison groups

	Patients with ACS (n=54)		95 PER CENT CI	Patients with PCI (n=68)		95 PER CENT CI	χ^2	p
	n	%		n	%			
Increase in PV	40	74,1	53,4–59,1	44	64,7	52,8–60,9	0,07	p<0,05

Decrease in PV	11	20,4	55,8–65,2	19	27,9	64,2–68,5	3,93	p<0,05
No change	3	5,5	63,9–67,1	5	7,4	2,53–124,5	0,69	p<0,05

Note: at $p<0.05$ - statistically significant difference of indicators between comparison groups

As can be seen from Table 2, after ACS there was an earlier and more significant increase in LV myocardial contractility indices compared to patients receiving PCI. By the first month of follow-up there was observed an increase of LV EF in 74,1% of patients in the first group and in 64,7% in the second group. On the contrary, the decrease of LV EF prevailed in patients of the group with PCI - 27,9% vs. 20,4% of patients in the group with ACS, which was significantly lower ($p<0,05$). Total contractility remained unchanged in 5.5% of patients in the group with ACS and in 7.4% in the group with PCI ($p<0.05$).

Table 3.

Dynamics of the main echocardiographic parameters in the comparison groups (n=122)

Indices	Terms	Patients with ACS (n=54)	Patients with PCI (n=68)	p
PV,%	Before surgery	58,1±8,4	60,8±9,4	p<0,05
	After 3 days	58,5±10,2	59,7±8,3	p>0,05
	After 2 weeks	60,03±9,4	60,04±8,9	p>0,05
	After 1 month	60,4±8,3*	61,9±8,2	p>0,05
LV EF, ml	Before surgery	115,4±32,3	103,9±31,4	p>0,05
	After 3 days	104,9±33,05*	98,6±30,9*	p>0,05
	After 2 weeks	103,7±27,2*	96,5±30,1*	p>0,05
	After 1 month	105,2±27,2*	97,0±29,2*	p>0,05
LV CSR, ml	Before surgery	48,7±22,1	42,1±23,7	p>0,05
	After 3 days	43,7±20,2*	40,3±22,8*	p>0,05
	After 2 weeks	43,4±18,1*	37,9±22,03*	p>0,05
	After 1 month	42,7±18,1*	38,6±22,5*	p>0,05

Notes: $p<0,05$ - reliability of differences between groups, $p>0,05$ - differences between groups are not reliable

Based on the table, both in the group with ACS and in the group with PCI, the volume indices of LV cavity after the operation tended to decrease compared to the initial values, as compared to the ejection fraction, which did not undergo significant changes. However, in the group with ACS, the improvement of LV contractility was found at the expense of this index from 58.14±8.4% to

60.4±8.3%, ($p<0.05$). If LV EF improved only by the first month of follow-up in the ACS group, the decrease of EF was observed already by the 3rd day after the surgical intervention from 115,4±32,3 ml to 104,9±33,05 ml, ($p<0,05$), and was maintained by the first month of follow-up 105,2±27,2 ml, ($p<0,05$). The same positive dynamics was observed in CSR, its decrease was noted 3 days after revascularisation from 48.6±22.1 ml to 43.68±20.2 ml, ($p<0.05$) and remained 42.7±18.07 ml, ($p<0.05$) by the first month of follow-up. The tendency to the decrease of CPP and CSR parameters in dynamics after ACS in comparison with preoperative data was also registered in the group with PCI, but it was less pronounced. A significant decrease of CSR from 42.1±23.7 ml to 38.6±22.5 ml ($p<0.05$) by the first month was found, while the EF decreased from 103.9±31.4 ml to 97.0±29.2 ml ($p<0.05$). Ejection fraction increased non-significantly from 60.8±9.4% to 61.9±8.2% , ($p>0.05$).

Conclusions: The results of our research work confirm the feasibility of performing surgical revascularisation by aortocoronary bypass surgery as one of the effective ways to treat CHD in multivessel lesions of coronary arteries. Myocardial revascularisation surgeries contribute not only to the improvement of contractility and slowing down of LV myocardial remodelling, but also to the improvement of diastolic properties.

References:

1. Karimova Sitara Anvarovna, Uralov Sardor Nejmatullo Ugli, Nasyrova Zarina Akbarovna Current Issues of Diagnostics and Treatment of Patients with Dilated Cardiomyopathy. AMERICAN Journal of Pediatric Medicine and Health Sciences, Volume 2, Issue 2, 2024 ISSN (E): 2993-2149, P.430-435
2. O'Gara PT, Kushner FG, Ascheim DD, Casey DE, Jr, Chung MK, de Lemos JA, Ettinger SM, Fang JC, Fesmire FM, Franklin BA, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;127:e362–425. doi: 10.1161/CIR.0b013e3182742cf6. [PubMed] [CrossRef] [Google Scholar]
3. Page BJ, Banas MD, Suzuki G, Weil BR, Young RF, Fallavollita JA, Palka BA, Canty JM., Jr Revascularization of chronic hibernating myocardium stimulates myocyte proliferation and partially reverses chronic adaptations to ischemia. *J Am Coll Cardiol*. 2015;65:684–697. doi: 10.1016/j.jacc.2014.11.040. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
4. Perry AS, Mann DL, Brown DL. Improvement of ejection fraction and mortality in ischaemic heart failure. *Heart*. 2020 doi: 10.1136/heartjnl-2020-316975. [PubMed] [CrossRef] [Google Scholar]
5. Pfeffer MA, Claggett B, Lewis EF, Granger CB, Køber L, Maggioni AP, Mann DL, McMurray JJV, Rouleau JL, Solomon SD, et al. Angiotensin receptor-neprilysin inhibition in acute myocardial infarction. *N Engl J Med*. 2021;385:1845–1855. doi: 10.1056/NEJMoa2104508. [PubMed] [CrossRef] [Google Scholar]
6. Potere N, Del Buono MG, Vecchié A, Porreca E, Abbate A, Dentali F, Bonaventura A. Diabetes mellitus and heart failure: an update on pathophysiology and therapy. *Minerva Cardiol Angiol*. 2022 doi: 10.23736/s2724-5683.22.05967-1. [PubMed] [CrossRef] [Google Scholar]
7. Rizamat Ziyadullaevich Mirzaev , Alam Mohd Shazeb, Nasyrova Zarina Akbarovna Clinical and Genetic Features of Unstable Angina Pectoris Depending on Various Psychosocial Risk Factors. *International Journal of Alternative and Contemporary Therapy*. 2024 , R.4-8 <http://medicaljournals.eu/index.php/IJACT>
8. Rizamat Ziyadullaevich Mirzaev , Ergashev Sunnatillo Dosiyo Ugli, Nasyrova Zarina Akbarovna Regularities of clinical condition of patients with ischemic heart disease with concomitant chronic obstructive pulmonary disease, *World Bulletin of Public Health (WBPH)* Available Online at: <https://www.scholarexpress.net> Volume-33, April 2024 ISSN: 2749-3644 , R.48-52
9. Rodriguez-Palomares JF, Gavara J, Ferreira-González I, Valente F, Rios C, Rodríguez-García J, Bonanad C, García Del Blanco B, Miñana G, Mutuberria M, et al. Prognostic Value of Initial Left Ventricular Remodeling in Patients With Reperfused STEMI. *JACC Cardiovasc Imaging*. 2019;12:2445–2456. doi: 10.1016/j.jcmg.2019.02.025. [PubMed] [CrossRef] [Google Scholar]
10. Russo JJ, Prasad M, Doshi D, Karpaliotis D, Parikh MA, Ali ZA, Popma JJ, Pershad A, Ohman EM, Douglas PS, et al. Improvement in left ventricular function following higher-risk percutaneous coronary intervention in patients with ischemic cardiomyopathy. *Catheter Cardiovasc Interv*. 2020;96:764–770. doi: 10.1002/ccd.28557. [PubMed] [CrossRef] [Google Scholar]

11. Swain L, Reyelt L, Bhave S, Qiao X, Thomas CJ, Zweck E, Crowley P, Boggins C, Esposito M, Chin M, et al. Transvalvular ventricular unloading before reperfusion in acute myocardial infarction. *J Am Coll Cardiol*. 2020;76:684–699. doi: 10.1016/j.jacc.2020.06.031. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
12. Torrado J, Cain C, Mauro AG, Romeo F, Ockaili R, Chau VQ, Nestler JA, Devarakonda T, Ghosh S, Das A, et al. Sacubitril/valsartan averts adverse post-infarction ventricular remodeling and preserves systolic function in rabbits. *J Am Coll Cardiol*. 2018;72:2342–2356. doi: 10.1016/j.jacc.2018.07.102. [PubMed] [CrossRef] [Google Scholar]
13. van der Bijl P, Abou R, Goedemans L, Gersh BJ, Holmes DR, Jr, Ajmone Marsan N, Delgado V, Bax JJ. Left ventricular post-infarct remodeling: implications for systolic function improvement and outcomes in the Modern Era. *JACC Heart Fail*. 2020;8:131–140. doi: 10.1016/j.jchf.2019.08.014. [PubMed] [CrossRef] [Google Scholar]
14. van Wezenbeek J, Canada JM, Ravindra K, Carbone S, Trankle CR, Kadariya D, Buckley LF, Del Buono M, Billingsley H, Viscusi M, et al. C-reactive protein and N-terminal pro-brain natriuretic peptide levels correlate with impaired cardiorespiratory fitness in patients with heart failure across a wide range of ejection fraction. *Front Cardiovasc Med*. 2018;5:178. doi: 10.3389/fcvm.2018.00178. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
15. Velagaleti RS, Vetter J, Parker R, Kurgansky KE, Sun YV, Djousse L, Gaziano JM, Gagnon D, Joseph J. Change in left ventricular ejection fraction with coronary artery revascularization and subsequent risk for adverse cardiovascular outcomes. *Circ Cardiovasc Interv*. 2022 doi: 10.1161/circinterventions.121.011284. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
16. Yancy CW, Jessup M, Bozkurt B, Butler J, Casey DE, Jr, Drazner MH, Fonarow GC, Geraci SA, Horwich T, Januzzi JL, et al. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2013;62:e147–239. doi: 10.1016/j.jacc.2013.05.019. [PubMed] [CrossRef] [Google Scholar]
17. Каримова Ситора Анваровна, Уралов Сардор Нейматулло угли, Насырова Зарина Акбаровна ГЕНЕТИЧЕСКИЕ АСПЕКТЫ ДИЛЯТАЦИОННОЙ КАРДИОМИОПАТИИ. ACADEMIC RESEARCH IN MODERN SCIENCE. International scientific-online conference. Published February 21, 2024. <https://doi.org/10.5281/zenodo.10687446>. P.50-52
18. Ташкенбаева Э. и др. Маркеры гиперурикемии как фактор риска и предикторы сердечно-сосудистых заболеваний //Журнал проблемы биологии и медицины. – 2016. – №. 2 (87). – С. 191-194.
19. Ташкенбаева Э. Н., Насырова З. А., Мирзаев Р. З. Стратификация хронической ишемической болезни сердца в зависимости от методов диагностики и пути их лечения //Journal of cardiorespiratory research. – 2020. – Т. 1. – №. 3. – С. 28-32.