Prognosis Innovative Approaches in Relation to Results and Complications of Coronary Remedial Surgical Procedure in Case of Acute Coronary Syndrome

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Abstract

In modern cardio surgery, it has become possible to predict not only the outcome of surgical interference in order to save life, but also its effectiveness in terms of the quality of life improvement. It is proved that coronaro correcting technologies can not only soften the clinical picture of chronic coronary insufficiency, but also increase the contractility of the ischemic myocardium, as well as significantly improve the patient's quality of life, if the myocardial ischemia has the character of hibernation, and not stanning. The ability to determine which variant of the ischemic syndrome occurs in the patient before surgery helps to predict the interference effectiveness. The method used for this purpose (radioisotope scintigraphy, positron emission tomography, MRI, pharmacological stress echotests) are technically or economically inaccessible, difficult to apply in the perioperative period, and sometimes dangerous.

The purpose of the research: to offer an informative, accessible and safe method of preoperative identification of the hibernating myocardium among patients with IHD for successful prediction of the interference effectiveness.

Materials and Method: 83 patients with acute and chronic forms of IHD were under study. In the first group (49 people), there was a coronary stenting (CS). In the second group (34 patients), there was a heart bypass surgery (HB). There was the comparative assessment analysis in regard to variant of ischemic syndrome and the effectiveness of both operations by means of precardial ECG mapping and stress echotest with dipyridamole.

Results: In case of IHD acute forms (acute coronary syndrome, acute myocardial infarction) CS and HB operations had significant positive dynamics in regard to indicators of coronary blood flow within the course of ischemia and myocardial contractility in accordance with precordial mapping (area reduction of ischemia - AST and the decrease of the ischemia degree - ΣST) and stress echotest with dipyridamole (increased contractility of EF indicator and a reduction of ESV, increase in the number of eukinetic segments of the myocardium and decrease of hypokinetic segments). We observed the same dynamics, but much less pronounced, in accordance with ECG mapping and stress echotest data after both operations within the group with chronic forms of ischemia.

Conclusion: The precardial ECG mapping is informative and available for use in regional cardiosurgical clinics as a method of the hibernating myocardium identification, which is a more perspective variant of ischemia in case of IHD in terms of left ventricular contractility increase.

Keywords: *Coronary stenting, coronary bypass, prognosis, stress echocardiography, ECG mapping.*

Introduction

Currently, the prognosis of outcomes and complications in surgical treatment has gone far from the primitive principle of the patient's chances comparison in regard to a favorable outcome within conservative and surgical treatment. We consider currently performed high-tech operations as the most complex and effective (but at the same time with risk possibility) among all known coronarocorrecting operations. The new data on the pathogenesis of coronary insufficiency and variants of ischemic syndrome have created a demand for such prognosis method that allow us to calculate not only the patient's chances of survival after surgery, but also the improvement possibility degree in regard to the pumping heart function. Whereby it makes available not only as "prognosis quo ad vitam ", that is, the prognosis for survival after surgery, but also as" prognosis quo ad valetudinem", that is, the prognosis in regard to the patient's quality of life after surgery. And one can determine it by which of the ischemic syndrome variants occurs in case of this patient.

Thus, in order to calculate the patient's chances to pass coronarocorrecting interferences with high positive result, it is important that the preoperative examination helps to detect the presence of a hibernating myocardium. Whereby in this variant of ischemic syndrome (unlike stanning) the improvement of coronary blood supply restores (or at least significantly improves) their contractile function. In case of coronary syndrome promising variant includes hibernating myocardium, and effective revascularization as a result coronarocorrecting operation, one can expect a significant increment of the left ventricle contractile ability with reduction of heart failure signs, a positive clinical dynamics and improvement in quality of life.

Currently, the most widely used in coronary surgery, that is, relatively accessible, simple and informative is the indirect method of the hibernating myocardium identification – the method of stress echocardiography with dobutamine (dipyridamole or nitroglycerin). However, this method is technically quite complex, in addition, during the perioperative period, it is dangerous for patients with acute forms of IHD. We have proposed a method of precardial ECG mapping for this purpose. The origins of this method refer to the 70s of the last century in order to estimate the size of the necrosis focus in case of myocardial infarction, the area of the so-called "peri-infarction zone", or the ischemic myocardial necrosis focus around it. We consider this zone as a zone of "critical blood supply" and, as practice confirms, when the coronary blood flow improves, it completely recovers and returns to the normally functioning myocardium. If the treatment was not quite effective, this zone increases the area of the necrosis focus with complete elimination from the heartbeat[1].

Materials and Method

In order to assess the prognosis reliability in relation to complications, outcome and effectiveness of surgery operation, we examined the status of the ischemic myocardium (a form of ischaemic syndrome) and its dynamics as a result of coronary correction by CS method, and also CABG method, in two groups of patients – with acute (acute coronary syndrome, acute myocardial infarction) and chronic (angina FC II-IV) forms of IHD with initial signs of heart failure. There was an integral assessment of the heart pumping function recovery based on the results of stress echotest with dipyridamole.

The study included 83 patients of both sexes (62 men and 21 women) in the age from 38 to 65 years (average age 54.3+1.21) with acute and chronic forms of IHD. There was randomization, in which the criteria of non-inclusion were: age≥65 years; acute myocardial infarction or acute stroke, a medical history of HB or CS operations; multifocal (more than 3 vessels) demages of the coronary bed; the presence of resistant arterial hypertension, chronic bronchopulmonary conditions, thrombophilic and anaemic syndromes, heart failure above grade II in accordance with NYHA. We established such criteria because the assessment did not refered to the effectiveness of any medical or surgical interference, but to the reliability of prognosis technology.

We divided the patients under study into 2 groups. The patients of the first group (49 people) passed coronary stenting. This group included 17 patients with acute and 32 patients with chronic forms of IHD.

The second group consisted of 34 patients with acute (11 people) and chronic (23 people) forms of IHD, who passed HB. A retrospective analysis showed that the age-sex structure of all subgroups differed slightly from each other.

We performed the precardial ECG mapping five times for all patients of both groups: before the interference, 30 minutes after the operation, and 1, 3, and 6 days after the operation.

We performed the pharmacological EchoCG test with dipyridamole twice-before the interference (for one day) and before the discharge.

Results and Discussion

The research results are in tables and diagrams.

Table 1: The dynamics of area (AST) and degree of myocardial ischemia (ΣST) among patients with acute and chronic forms of IHD during treatment with the CS method

№	Time of study	ACS, AMI		CCI		P_{1-3}	P_{2-4}
		AST (M±m)	ΣST (M±m)	AST (M±m)	ΣST (M±m)		
1	Before surgery	27,84±1,66	88,42±6,67	8,13±2,81	10,81±3,11	p<0,02	p<0,001
2	After 30 ‘ p/operation	27,17±1,04***	63,19±4,48***	6,47±1,12	7,46±2,88	p<0,01	p<0,001
3	1 day	25,34±2,11***	52,68±6,64***	6,15±0,92	6,93±1,27	p<0,02	p<0,001
4	3 day	23,76±0,86***	48,46±6,40***	5,44±0,86	5,12±1,88	p<0,01	p<0,001
5	6 day	17,32±1,08***	54,17±6,18***	4,78±0,46	4,64±1,26	p<0,01	p<0,001

***High degree of statistical significance (p<0.02) between 1-2, 1-3, 1-4, 1-5.

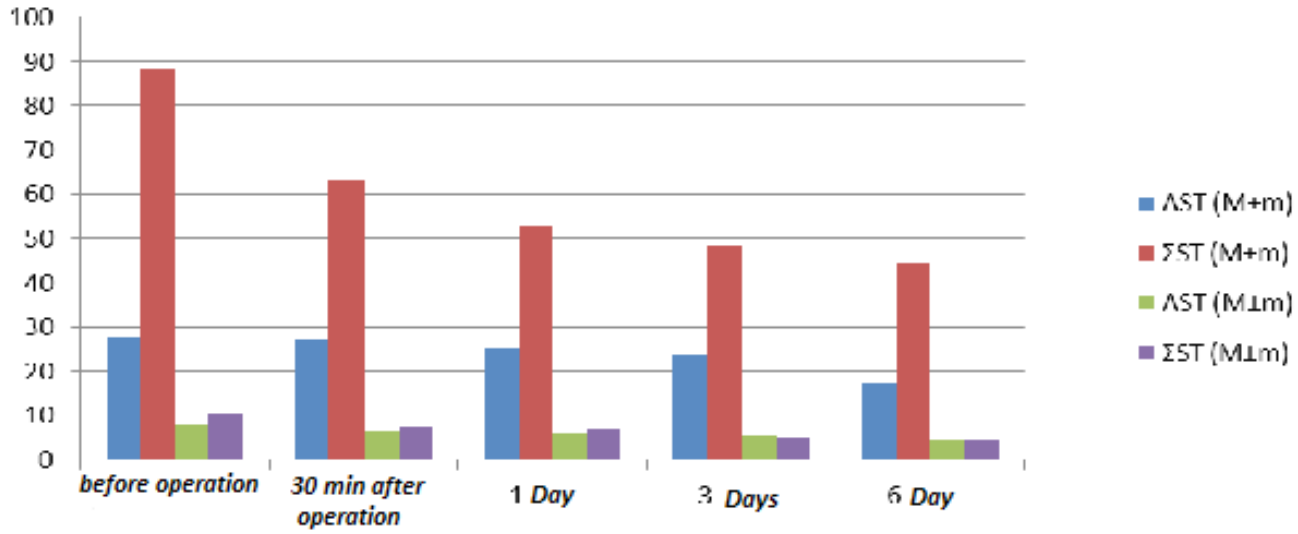

Diagram 1: The dynamics of area (AST) and degree of myocardial ischemia (ΣST) among patients with acute and chronic forms of IHD during treatment with the CS method

Table 2: The dynamics of area (AST) and degree of myocardial ischemia (ΣST)among patients with acute and chronic forms of IHD during treatment with the HB method

Time of study	ACS, AMI		CCI		P_{1-3}	P_{2-4}
	AST (M±m)	ΣST (M±m)	AST (M±m)	ΣST (M±m)		
Before surgery	27,50±1,93	92,34±4,93	9,25±1,67	8,31±1,29	p<0,02	p<0,005
After 30 ‘ p/operation	24,67±1,20	67,58±8,04	10,27±2,53	11,69±2,17	p<0,02	p<0,005
1 day	20,83±1,42	57,17±8,26	8,77±3,14	9,25±1,75	p<0,02	p<0,005
3 day	19,50±1,02	50,34±7,21	6,17±2,35	7,62±1,14	p<0,02	p<0,005
6 day	18,83±1,30	36,67±8,89	5,81±1,62	5,64±1,28	p<0,02	p<0,005

***High degree of statistical significance (p<0.02) between 1-2, 1-3, 1-4, 1-5.

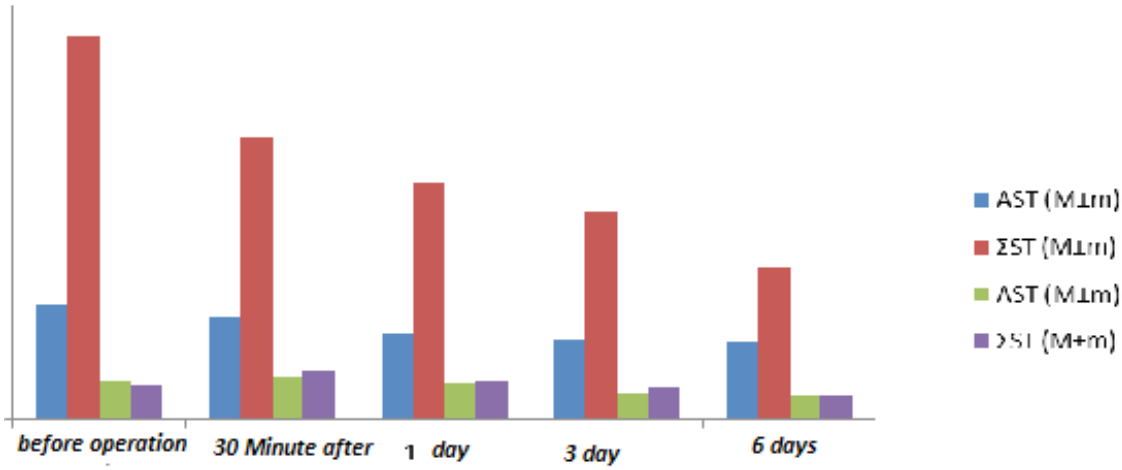

Diagram 2: The dynamics of area (AST) and degree of myocardial ischemia (ΣST) among patients with acute and chronic forms of IHD during treatment with the CABG method

As can be seen from the data provided in tables 1 and 2, we selected patients with clinically pronounced forms of the disease, with demonstrative laboratory and instrumental shifts, for both CS and CABG surgery operations. It is evident from the high initial indicators of affected area filed (AST) and degree of ischemization (ΣST) in both groups (conservative and surgical treatment). Almost all of them are active, working, highly educated people with a fairly high social status, "advanced" in the achievements of modern medicine, who value this status and their work. That is why, in contrast to conservative patients, within the choice between the proposed medication and surgical method of treatment, they preferred surgical interference. The main motivator of this choice was that the operation, even if there is a certain risk, provides a higher quality of life, gives more prospects to save the ability to work.

Both among patients treated with the CS method and in the group who passed HB, from the 1st day to the end of observation (day 6), there was a rapid and statistically significant ($p<0.02$) positive dynamics both in terms of area reduction (AST c 27.84±1.66 in the CS group, as well as from 27.50±1.93 in the HB group before surgery to 17.32±1.08 and 18.83±1.30 by day 6, respectively), and in aspect of the myocardial ischemia degree (ΣST c C 88.42±6.67 and 92.34±4.93 before treatment, up to 54.17±6.18 and 36.67±8.89 by day 6 in both groups, respectively).

In the groups with chronic IHD, treated by method of CS and HB, the results of ECG-mapping were less clear, however, quite convincing. Here, however, the elevation is not typical, but depression of the ST segment (which is specific for CCI) and this shift is less obvious than in acute forms of IHD – usually within 1-2 mm of the isoelectric line.

As can be seen from tables 1 and 2, the initial (pre-operation) indicators of the area and degree of myocardial ischemia in both groups were almost identical – AST, both in the CS group, and CABG, respectively, 8.13±2.81 and 9.25±1.67, and ΣST, respectively, 10.81±3.11 and 11.27+2.64. The dynamic control within the specified time period also demonstrated positive, but significantly slower changes of the ST segment than among patients with acute forms of IHD: by day 6, the AST indicator decreased within both groups to 5.81±1.12 and 6.19+2.03 (P0,05), respectively.

In our opinion, this difference in the extent and severity of myocardial ischemia among patients with acute and chronic forms of IHD reflects the difference in the state of the myocardium in two different variants of ischemic syndrome. It means that in acute forms, the hibernating state prevails, and in chronic forms – stanning. In order to confirm (or exclude) our assumption, we performed a pharmacological EchoCG test with dipyridamole.

We performed this functional test in accordance with the recommendations of the European Echocardiographic Association[2]. We performed the test twice-before the operation and on the 6th day after operation.

we performed the pharmacological stress echotest with dipyridamole among 28 patients from a sample in which there was ECG mapping in order to assess the effect of HB or CS surgery. In each of 4 groups, we

selected 7 patients by method of random sampling (group 1-ACS, who passed HB; group 2-with chronic IHD, who passed HB; group 3 – ACS, who passed CS; group 4 – with chronic IHD, CS). The criteria of non-inclusion: 1) severe conduction abnormality; 2) patients with chronic bronchopulmonary diseases with bronchoobstructive syndrome (bronchoconstrictor effect of dipyridamole); 3) hypotension with systolic A/D<100 mmHg.

The data on changes in cardiodynamic parameters (ejection fraction-EF and final systolic volume - ESV) among patients with ACS before and after CS and CABG operations in accordance with the echo test with dipyridamole are in table 3 and diagram 3.

Table 3: The changes in cardiodynamic parameters and local contractility among patients with acute forms of IHD during CS and HB surgery operations in accordance with the EchoCG test with dipyridamole

The indicators of cardiodynamics and local contractility	CS		HB	
	Before the CS surgery operation	6th day after CS	Before the HB surgery operation	6th day after HB
ESV, ml	114,6±4,3	77,3±3,1	109,6±4,3	74,3±3,4
EF, %	45,8±6,4	55,4±8,3	47,5±7,1	56,3±6,6
The LV segments:				
Eukinetic	168,4±7,0	232,8±6,2	192,6±5,7	236,7±8,4
Hypokinetic	62,2±4,1	24,5±2,2	62,3±4,4	32,5±2,4
Akinetic	58,3±5,6	32,4±3,5	34,5±3,1	20,1±1,7

As can be seen from table 3, before surgical interference of both types, patients showed a slight increase in ESV, which we associate with the area of the ischemic zone and indicates the latent heart failure. The degree of ESV increase in both groups was approximately the same, and the difference between them was statistically unreliable (p>0,1), which indicates the comparability of patients in both groups.

We confirmed the presence of left ventricular contractility disorders among patients of both groups by a decrease in the EF index. Moreover, these indicators among the patients of both groups did not differ significantly (p>0,2), which indicates a qualitative randomization.

By the 6th day after surgery (both in the HB group and in the CS group), myocardial contractility increased statistically in a valid way (p<0,02).

Moreover, there was a solid confirmation of such dynamics by both EchoCG indicators – both a decrease in ESV and an increase in EF (p <0.02).

Such character of changes in cardiodynamic is quite consistent with the dynamics of precordial ECG mapping indicators that showed in both groups statistically significant (p>0,02) improvement of coronary circulation within the ischemic area, both in terms of its vastness (by AST, p<0.05), and in terms of reducing the extent of ischemia (by ΣST, p<0,02).

The pronounced and rapid (in less than a week after surgery, recovery of coronary blood flow) improvement of the ischemic myocardium state and its contractility in accordance with the EchoCG test with dipyridamole helps us to explain the achieved positive effect of both surgery types by the fact that in ACS there is a hibernating version of the ischemic syndrome. While in the case of stanning, it would be impossible to count on such a rapid and pronounced positive effect of surgery. To confirm this assumption, we conducted a pharmacological EchoCG test with dipyridamole within a group of patients with chronic IHD.

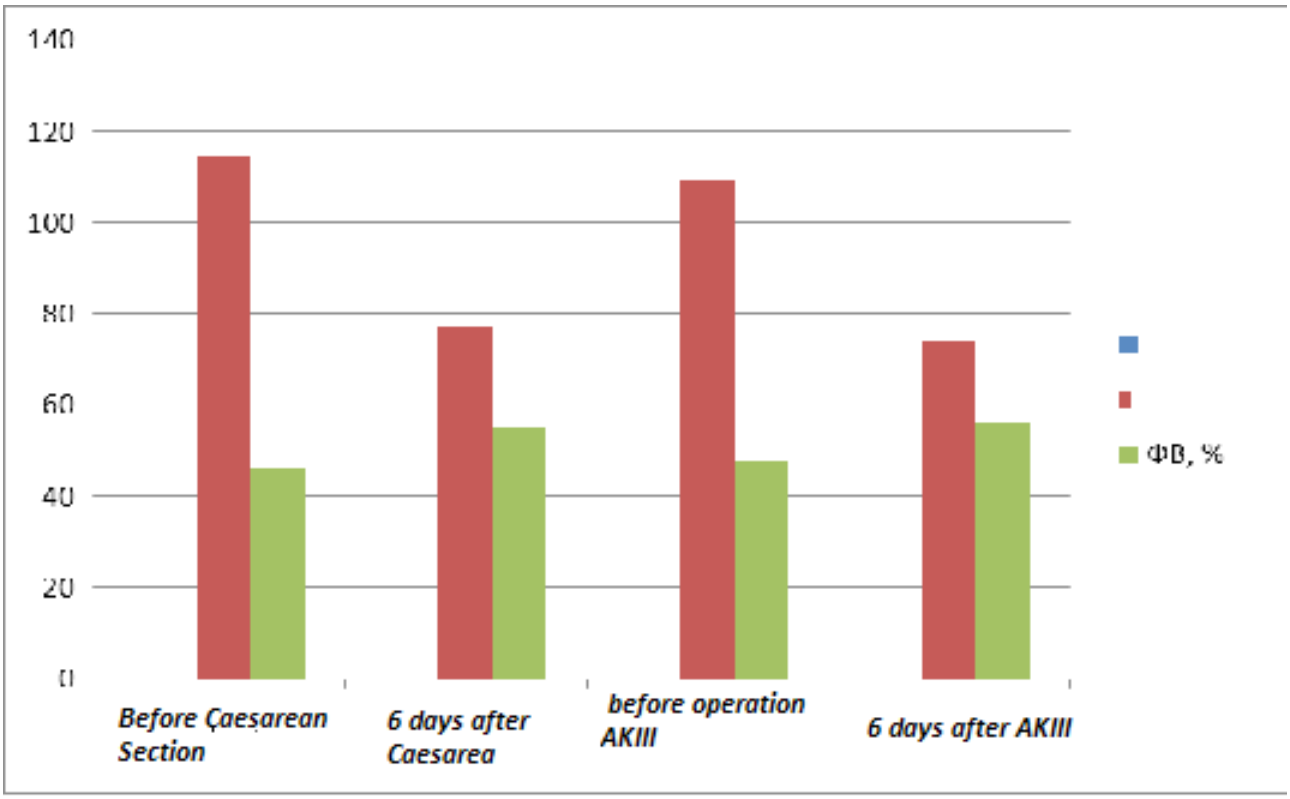

Diagram 3: The dynamics of ECHOCG parameters (ESV, EF) during CS and HB operations before and after the interference

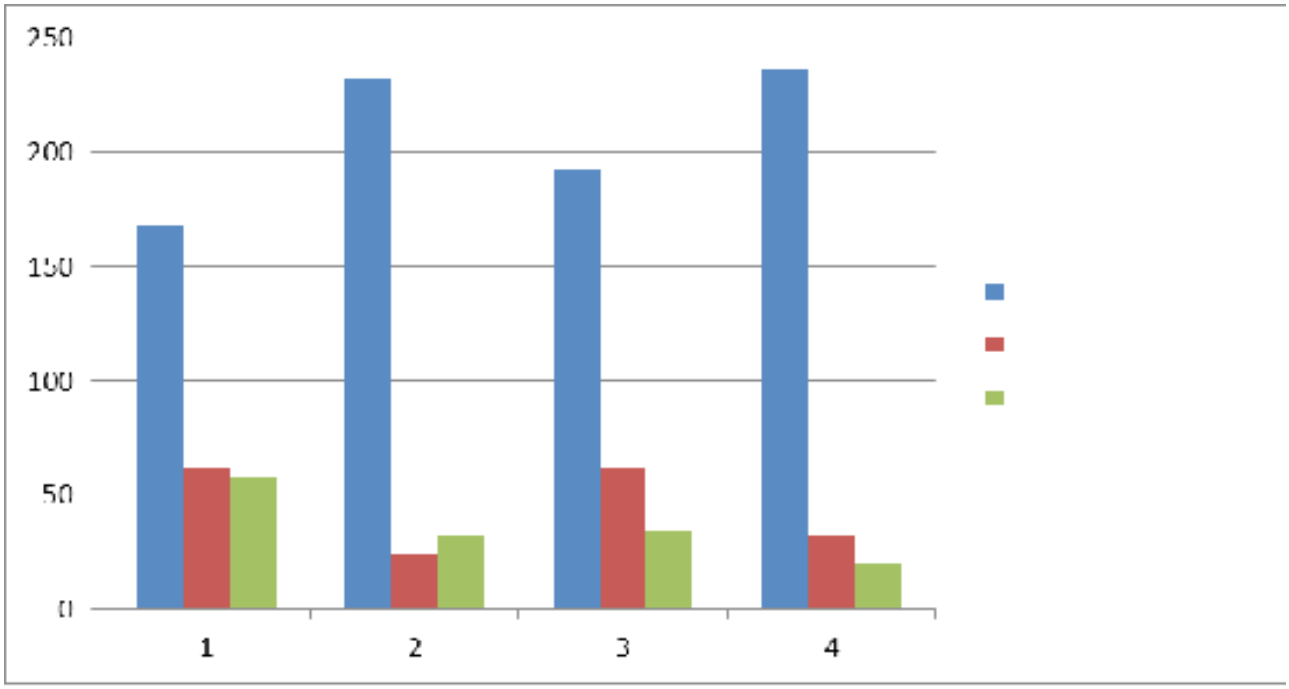

Diagram 4: The dynamics of the myocardial segments kinetics during CS and HB operations before and after the interference

Table 4: The changes in cardiodynamic parameters and local contractility among patients with chronic forms of IHD during CS and HB surgery operations in accordance with the EchoCG test with dipyridamole

The indicators of cardiodynamics and local contractility	CS		p	HB	
	Before the CS surgery operation	6th day after CS		Before the HB surgery operation	6th day after HB
ESV, ml	101,4±2,6	93,4±6.3	>0,05	113,1±3,7	69,3±6,1
EF, %	49,9±6,8	55,4±5,6	>0,05	42,2±5,1	53,3±4,8
The LV segments:					
Eukinetic	196,3±0,1	212,6±1,5	<0.05	188,4±1,1	202,9±0,6
Hypokinetic	43,0±3,3	28,3±4,1	>0,05	58,3±2,9	43,1±2,2
Akinetic	36.6±1,7.	29,5±5,0	>0,05	36,7±2,2	28,9±1,4

As can be seen from the table, among patients of both groups, in accordance with EchoCG data, there was initially a significant decrease in myocardial contractility, manifested by an increase in left ventricular of ESV and decrease of LV. It is natural, since it is known that the main markers of blood supply deterioration are chest pain (optional symptom) and segmental decrease in left ventricular pumping function (obligate symptom), usually without clinical indication and with identification by instrumental method.

The analysis of changes in cardiodynamic parameters (in accordance with the EchoCG test with dipyridamole) within two groups of patients with chronic IHD (treated with CS and HB) revealed the absence of significant improvement in left ventricular contractility after surgery to improve coronary blood flow, both by this and another method. Both indicators under study, both ESV and EF, showed some improvement, which became statistically unreliable (p>0,05). It would be groundless by definition to expect more significant changes – as is known, the term "stoned myocardium" refers to an ischemic area of the heart muscle, in which the maximum possible recovery of coronary blood supply has already occurred within these conditions (+at the expense of a decrease in coronary spasm, neoangiogenesis, recanalization of the thrombus; - at the expense of akinesia and hypokinesia). Such conclusion bases on the EchoCG research results of local myocardial contractility-in both groups of patients within the postoperative period,there was a statistically significant p<0,05 increase in the number of eukinetically shrinking segments,while the reduction in the number of hypo – and akinetic segments was statistically insignificant (p>0,05). Consequently, this suggests that in acute variants of IHD, there is hibernation of myocardium (reduction of heart function to a level adequate to reduce coronary perfusion in order to save persistent cardiomyocytes), when the restoration of blood flow leads to the restoration of full ischemic cardiomyocytes functioning. In contrast to stanning, in which chronic coronary hypoperfusion within chronic variants of IHD leads to an irreversible decrease in the contractile function of the LV myocardium (complete absence of persistent cardiomyocytes in the presence of Hypo - and akinetic sections of the myocardium).

As an illustration, we present extracts from the medical histories of operated patients.

Conclusion

The precardial ECG mapping is informative and available for use in regional cardiosurgical clinics as a method of the hibernating myocardium identification, which is a more perspective variant of ischemia among patients with IHD in aspect of left ventricular contractility increase.

Ethical Clearance: No ethical approval is needed.

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Conflict of Interest: Nil

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