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CENTRAL AND INTRACARDIAC HEMODYNAMICS IN PATIENTS WITH PROGRESSIVE ANGINA PECTORIS DEPENDING ON THE PRESENCE OF DIABETES MELLITUS AND THE NEED FOR REVASCULARIZATION

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Abstract: Ischemic heart disease (IHD) against the background of diabetes in most of its course has characteristic clinical features. They are determined by both the severity and the duration of diabetes. The manifestation of diabetes in patients often occurs against the background of existing pathological conditions of the cardiovascular system.

Keywords: revascularization, hemodynamics, myocardial, diabetes

Introduction. The presence of diabetes mellitus (DM) as a background pathology aggravates the course of any disease in view of the high risk of disability of patients due to the development of diabetic vascular (mainly microvascular) complications of the kidneys (renal glomeruli), retina of the eyes, gastrointestinal tract, lower extremities, heart and the brain [1]. In the structure of total mortality from diabetes, the proportion of cardiovascular accidents, in particular myocardial infarction as a direct cause of death, is, according to the literature, 30–50% [2,3].

Ischemic heart disease (IHD) against the background of diabetes in most of its course has characteristic clinical features. They are determined by both the severity and the duration of diabetes. The manifestation of diabetes in patients often occurs against the background of existing pathological conditions of the cardiovascular system. This category of patients is often diagnosed with the so-called "mute" or painless forms of ischemic disorders, a high risk of sudden death. On coronary angiography, this category of patients often has diffuse lesions involving the distal parts of the coronary bed, which in turn complicates the manipulation of myocardial revascularization [4.5].

Objective: to study the features of central and intracardiac hemodynamics in patients with progressive angina pectoris, depending on the presence of diabetes mellitus and the need for revascularization.

Materials and research methods

To achieve this goal, the study included 329 patients (follow-up period from 2011 to 2016) hospitalized at the Republican Scientific Center for Emergency

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Medicine of the Ministry of Health of the Republic of Uzbekistan with a diagnosis of ischemic heart disease, unstable angina pectoris (USAP). The study included patients only with progressive USAP variant. Patients, depending on the presence of diabetes, were divided into 2 groups; group 1 (n = 179) patients with USAP and DM and group 2 USAP without DM (n = 150). As a control group (CG, n = 20), 20 healthy volunteers of comparable age without signs of cardiovascular and endocrine pathology, including vegetative ones, were examined.

The exclusion criteria were: rhythm disturbances in the form of atrial fibrillation and atrial flutter (persistent form), valvular and congenital heart defects, acute inflammatory and febrile conditions, oncological diseases, diffuse connective tissue diseases and systemic vasculitis, erosive and ulcerative lesions of the gastrointestinal tract, failure the patient from participation in the study and/or endovascular procedure (coronary angiography - (CAG) with stenting of the coronary arteries - (CA)).

The diagnosis of ischemic heart disease, unstable angina pectoris, was established on the basis of: clinical data, ECG recorded during a painful attack or upon admission to the clinic (without ST segment elevation) and a negative troponin test.

All patients included in the study, during the first 24 hours of hospitalization, underwent diagnostic CAG, based on the results of which a decision was made on the further tactics of patient management. Patients, depending on the therapy, were divided into 3 groups: 1-patients who underwent PTCA with stenting-260 (79%), 2-patients who underwent aorta coronary bypass grafting (ACABG) -65 (19.7%), 3-patients who underwent drug therapy -4 (1.2%).

Statistical processing of research results

Statistical processing was carried out with the calculation of group arithmetic mean values, their standard deviations. In the case of using the median, the indicators were described with an indication of the range of values. Intergroup differences were assessed using Student's t-test for paired and unpaired comparisons. For multiple comparisons, Student's test with Bonferoni's correction was used for multiple comparisons. In the case of nonparametric values, the differences in the frequency of occurrence of the trait were assessed using the tabular chi-square test and the assessment of its reliability using tables depending on the number of degrees of freedom.

Research results

EchoCG study found that in patients with coronary artery disease included in the present study, compared with CG, there is a significant change in the geometry of the heart within the framework of ischemic remodeling: an increase in chamber volumes (an increase in the volume index of the left atrium (LA), indexed to the body

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surface area, the end diastolic volume (LVEDVI), diameter of the right ventricle (RV), p <0.001 compared with CG, Table 1), spherical deformity of the left ventricular (LV) cavity (increase in LV sphericity index, p<0.001) and an increase in the mass of the left ventricular myocardium indexed to body surface area (MMILV) (p <0.001). At the same time, a comparison of patients with diabetes and without diabetes among themselves revealed that in the group with diabetes the sizes of the left heart chambers and MMILV were significantly larger than among patients without diabetes (p <0.05 for LAI and LVEDVI and p <0.001 for the sphericity index LV and MMILV). RV size was comparable regardless of the presence of diabetes.

Table № 1

EchoCG indicators in patients with unstable angina pectoris depending on the presence of background diabetes

	Index	**all IHD (n=329)**	**with DM (n=179)**	**without DM- (n=150)**	**CG (n=20)**
	LV EF, %	55,21±6,67***	53,58±6,77***	55,87±6,36^^^***	64,85±4,91
	LAI, ml/m^2	31,03±19,93***	34,59±12,03***	28,33±26,08^***	19,40±4,75
	LV EDVI, ml/m^2	101,01±17,79***	104,46±17,52***	99,87±17,85^***	78,60±10,58
	LV sphericity index, relative to one	0,89±0,27***	0,97±0,29***	0,84±0,22^^^***	0,57±0,14
	IVRC, unit	1,11±0,11***	1,14±0,12***	1,09±0,09^^^***	1,00±0,00
	ISRI, % relative unite	67,32±27,76***	62,22±26,35***	73,39±28,25^^^***	121,74±31,69
	e'/a' LV, relative unite	0,81±0,32***	0,70±0,30***	0,84±0,32^^^***	1,53±0,15
	MMILV, gr/m^2	126,15±20,59***	131,52±21,21***	123,54±19,01^^^***	97,60±10,48
	Tei LV, relative unite	0,39±0,11***	0,42±0,11***	0,36±0,11^^^***	0,28±0,06
0	RV, cm	2,54±0,48***	2,58±0,49***	2,51±0,46***	2,10±0,42

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1	TAPSE, mm	15,39±5,61***	13,31±5,41***	16,39±5,40^^^***	26,50±3,63
2	e'/a' RV, relative unite	0,86±0,40***	0,81±0,42***	0,86±0,38***	1,56±0,17
3	PWP, mmHg	17,47±4,80***	18,82±4,83***	16,78±4,54^^^***	10,50±1,70
4	PSS, mmHg	28,77±4,80***	29,68±4,77***	28,51±4,77^***	22,65±2,74
5	Tei RV, relative unite	0,35±0,10***	0,38±0,11***	0,33±0,09^^^***	0,23±0,04
6	total Tei, relative unite	0,75±0,16***	0,80±0,16***	0,69±0,14^^^***	0,51±0,07

Note: the reliability of the difference with the indicators of CG-, between patients with diabetes and without diabetes-^, between the groups PTCA and ACABG-#. One sign – p<0.05, two signs-p<0.01, three signs-p<0.001. IVRC- index of violation of regional contractility, ISRI integral systolic remodeling index*

The distribution of patients depending on the need for revascularization revealed that in patients requiring ACABG, LVEDVI and LV sphericity index (p <0.001 for both parameters), as well as RV size (p <0.05), were greater than in patients who require percutaneous translucent coronary angioplasty (PTCA). Table 2).

Table 2

EchoCG indices in patients with unstable angina pectoris depending on the type of revascularization

	Index	PTCA (n=260)	*ACABG* (n=65)
	LVEF, %	55,66±6,65	50,88±5,28###
	LAI, ml/m^2	31,05±21,51	33,83±12,17
	LVEDVI, ml/m^2	100,14±18,11	110,71±13,88###
	LV sphericity index, relative to one	0,86±0,26	1,09±0,26###
	IVRC, unit	1,11±0,11	1,15±0,11##
	ISRI, % relative unite	71,75±28,40	50,50±17,34###
	e'/a' LV,	0,81±0,31	0,59±0,29###

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	relative unite		
	MMILV, gr/m^2	126,86±20,59	132,48±20,55
	Tei LV, relative unite	0,39±0,11	0,41±0,11
0	RV, cm	2,52±0,48	2,68±0,44#
1	TAPSE, mm	15,13±5,62	13,29±5,31#
2	e'/a' RV, relative unite	0,88±0,39	0,62±0,37###
3	PWP, mmHg	18,00±4,77	17,65±4,98
4	PSS, mmHg	28,62±4,75	31,11±4,58###
5	Tei RV, relative unite	0,36±0,10	0,36±0,11
6	total Tei, relative unite	0,75±0,16	0,77±0,17

*Note: the reliability of the difference with the indicators of CG - *, between patients with diabetes and without diabetes - ^, between the groups of PTCA and CABG - #. One sign - p <0.05, two signs - p <0.01, three signs - p <0.001.*

The ejection fraction (EF) of the LV in patients with coronary artery disease, although it remained on average within the normal range, was significantly lower than in the CG (p <0.001). A more detailed analysis showed that, in general, in 171 (52%) patients, LVEF was below 55%.

At the same time, decreased LVEF in patients with unstable angina pectoris was associated with the presence of background diabetes (n = 108, (p <0.001)), (in the PTCA group in 71 (65.7%), coronary artery bypass grafting (ACABG) in 35 (32.4%).

Another indicator of LV myocardial systolic function, the regional contractility impairment index, was assessed using a 17-segment LV model. More than half of the patients (211 people - 64%) had violations of regional contractility (IVRC more than 1). At the same time, regional dyskinesis, as well as reduced overall contractility, is associated with the presence of background diabetes (n = 124, (p <0.05), (84 (68%) in the PTCA group, 38 (31%) ACABG.

Analysis of LV diastolic function revealed a significant tendency to impairment of the processes of active diastolic relaxation of the LV myocardium, which was manifested by a decrease in the ratio e '/ a', determined during tissue Doppler sonography of the lateral edge of the mitral annulus. Comparison of patients with diabetes and without diabetes revealed a greater degree of diastolic dysfunction in patients with background diabetes (p<0.001), and this difference remained only in patients who required endovascular revascularization (p<0.01), while among patients

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in the group ACABG, there was no difference in the e '/ a' ratio depending on the presence of diabetes mellitus.

(in (group PTCA in 101 (70%), ACABG in 41 (28.4%)). Frequency analysis confirms the described patterns: the highest incidence of diastolic dysfunction is observed in groups with diabetes and ACABG.

The integral index of the functional state of the myocardium - Tei, reflecting the ratio of the sum of the periods of "closed valves" (the period of isometric tension and isometric relaxation) to the time of ejection, in the patients included in the present study significantly exceeded the indicator characteristic of CG ($p < 0.001$).

At the same time, the highest value was noted in patients with background diabetes ($p < 0.001$ compared with patients without diabetes). There were no differences in LV Tei depending on the required revascularization method, however, in the PTCA group, the difference between patients with DM and without DM remained ($p < 0.001$).

The consequence of impaired LV functional state, especially its diastolic dysfunction, is an increase in pulmonary artery wedge pressure (PAWP), reflecting postcapillary pulmonary hypertension. In our study, in patients with coronary artery disease, especially with background diabetes, PAWP was higher than in the CG, although it remained on average within the groups within the normal range ($p < 0.001$ comparison of patients with IHD and CG and comparison of patients with diabetes and without diabetes).

There was no dependence of PAWP on the remodeling method, while in the PPCA group there was a difference in PAWP between patients with DM and without DM (higher in patients with DM, $p < 0.001$). Analysis of the incidence of patients with increased postcapillary pulmonary pressure (Table 3) showed that in the present study, an increase in PAWP was associated only with the presence of background diabetes ($p < 0.01$) and did not depend on the revascularization method.

Table №. 3

Distribution of patients with postcapillary pulmonary hypertension depending on the presence of diabetes mellitus and the required revascularization method

Study groups	**Total by groups**	**PTCA (n=260)**	**ACABG (n=65)**
		66 (25%)	16 (25%)
with DM (n=179)	55 (30,73%)	43 (33)	12 (25%)
without DM (n=150)	27 (18%)	23 (18%)	4 (21%)

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In combination with PAWP, we also determined the level of systolic pressure in the pulmonary artery. It was found that in patients with ischemic heart disease with unstable angina pectoris, there is an increase in pressure in the pulmonary circulation ($p < 0.001$ compared with the CG) with the maximum effect in patients with diabetes ($p < 0.05$ compared with patients without diabetes). It was also found that, in contrast to PAWP, systolic pressure in the PA depended on the required revascularization method: for example, in patients of the ACABG group it was significantly higher than in the PTCA group ($p < 0.001$). This pattern persisted within the group with diabetes ($p < 0.001$ between the PTCA and ACABG subgroups), but not in the group without diabetes.

Moreover, in the ACABG group in patients with diabetes, the pressure in the LA was higher than in patients without diabetes ($p < 0.05$). A likely explanation for these patterns can be the following - the need for surgical revascularization presupposes a large area of ischemia, including that extending to the RV myocardium, thus, the pathogenesis of pulmonary hypertension in patients with IHD, unstable angina pectoris is associated not only with LV ischemia, but also with RV. The highest incidence of pulmonary hypertension was observed among patients in the ACABG group and did not depend on the presence of background diabetes (Table 4).

Table 4

Distribution of patients with pulmonary hypertension depending on the presence of diabetes mellitus and the required revascularization method

Study groups	**Total by groups**	**PTCA (n=260)**	**ACABG (n=65)**
		66 (25%)	16 (25%)
with DM (n=179)	55 (30,73%)	43 (33)	12 (25%)
without DM (n=150)	27 (18%)	23 (18%)	4 (21%)

Conclusions:

1. In the present study, in patients with IHD with unstable angina pectoris, pronounced structural and functional remodeling of the left heart with an increase not only in the volume of the heart cavities, but also in the mass of the myocardium, as well as a violation of the functional state of the myocardium and systolic and diastolic function of the left ventricle.

2. Background diabetes was associated with more pronounced disorders, which can be explained both by a more widespread lesion of the coronary bed and a greater degree and area of ischemia, as well as with disorders of cell metabolism and accumulation of interstitial substances characteristic of diabetes.

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3. More pronounced disorders were observed in patients who required surgical revascularization, which is probably associated with a larger ischemic zone.

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