Results of angiographic research of coronary vessels in patients with type 2 diabetes mellitus and myocardial infarction

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ABSTRACT

High risk of vascular complications in diabetes foundation gave the American Heart Association ranked diabetes to diseases of the cardiovascular system. More than 60% of patients with type 2 diabetes life expectancy will be reduced by the development of their coronary artery disease, diabetes was an independent factor that increases the risk of myocardial infarction (2-3 times), stroke (more than 2 times) independently of other known risk factors for cardiovascular disease and acute coronary events are characterized by the extremely serious nature against the background of pronounced coronary atherosclerosis. In the present study, a comparative assessment of the frequency of coronary vessels of different severity in patients with myocardial infarction in the presence of diabetes and without. Status of the coronary vessels were studied by means of selective coronary angiography. The study found that in patients with myocardial infarction in combination with type 2 diabetes is much more frequent multivessel disease and coronary delay the passage of contrast material than patients with MI without diabetes. These features and characteristics of coronary lesions in patients with diabetes and myocardial infarction may explain why more severe myocardial infarction with frequent development of coronary events in these patients. After analyzing the data obtained, it can be assumed relationship progression of vascular lesions with concomitant coronary glycemic decompensation.

Introduction

Type 2 diabetes mellitus (T2D) is a serious and common chronic disease resulting from a complex factors including hereditary and environmental epigenetic influences, obesity, sedentary lifestyle. T2M is known as a major risk factor for cardiovascular disease (CVD), which is the most common cause of death among adults with diabetes mellitus. In addition to atherogenic dyslipidemia and other traditional risk factors for atherosclerosis, T2D is characterized by specific detremental factors such as hyperglycemia, hyperinsulinemia, insulin resistance, endothelial dysfunction. It is shown that the atherosclerotic leason of coronary vessels (macroangiopathy), lies at the basis of cardiac ischemia in diabetic patients [1-7]. A meta-analysis of trials of intensive glycemic control (such as DCCT, UKPDS, EDIC, ACCORD, ADVANCE, VADT) suggests that glucose lowering in diabetes mellitus may have a modest but statistically significant reduction in major CVD outcomes, primarily nonfatal miocardial infarction (MI), but no significant effect on mortality [8-14]. However, any such benefit of glucose lowering on CVD is slight compared with the treatment of other CVD risk factors [6]. Based upon the results of multiple cardiovascular outcome trials, new treatment recommendations for adults with type 2 diabetes pesented by ADA (2017), suggesting a pathway for people with heart disease that should include primarily glycemic controle interventions (lifestyle management and

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metformin), following by a medication to improve heart health [15]. At present, significant progress has been made in studying the pathophysiology of T2D and mechanisms of its adverse effect on the development of atherosclerosis, coronary artery disease and MI from the standpoint of the current concept of "total risk". According to this doctrine, the combination of several risk factors contributes to an intensive lesion of the vascular wall and the rapid development of fatal vascular complications in diabetes [16]. Angiographic studies showed that in T2D, more unstable plaques and intracoronary thrombi are detected. T2D, in associating with such factors as insulin resistance, arterial hypertension, microangiopathy, increases the risk of complications and adverse outcomes of MI [5,17,18]. Patients with T2D and IM are characterized by a more frequent development of congestive heart failure, repeated MI. The expansion of the necrosis zone and recurrent myocardial ischemia, in parallel with widespread atherosclerosis of the coronary arteries and diabetic cardiopathy are the factors aggravating left ventricular dysfunction. Almost 40% of diabetic patients who survived after the first MI, during the next two years develop a second MI, in most cases fatal [18]. Despite significant achievements in the study of pathogenetic mechanisms of MI development in patients without carbohydrate metabolism disorder, many issues still remain uncertain regarding the effects of hyperglycemia on the course and outcome of MI in diabetic patients. In particular, the actual task is to establish the interrelationships between individual pathogenetic mechanisms of accelerated atherogenesis, which will allow to expand the possibilities of therapeutic influence on these processes.

Materials and methods

Coronarography data were analyzed in 79 patients with MI (including 33 men, or 41.8% and 46 women, or 58.2%). The average age of women was 64 ± 6 years, ranging from 56 to 68 years; men 59 ± 4 years, from 55 to 64 years. In 46 patients (57.6%), anterior localization of MI and in 33 patients (42.3%), the posterior localization of MI was diagnosed.

Clinical examination included the collection of anthropometry data, anamnesis and complaints, the elucidation of risk factors, peculiarities and clinical course of the disease, physical examination (measurement of blood pressure and pulse), carrying out laboratory and instrumental methods of research necessary for the diagnosis. A clinical diagnosis was established, the type, degree of severity of diabetes mellitus, the nature and extent of diabetic vascular disorders were determined. The diagnosis of acute myocardial infarction was established according to the diagnostic triad: burning, compressive, pressing pains behind the breastbone, refractory to nitroglycerin; electrocardiographic data (ST segment elevation of not less than 1 mV in two adjacent leads with the subsequent formation of abnormal Q teeth); assessment of the blood markers of myocardial necrosis. For the diagnosis of MI, at least 2 of the 3 criteria were required. Diagnosis of type 2 diabetes was established using WHO criteria (1999). Exclusion criteria from the study were type 1 diabetes, valvular disease, the development of clinical symptoms earlier than 24 hours before admission. The clinical and angiographic characteristics of coronary vessels were studied using selective coronary angiography. In 76.5% patients, coronary angiography was performed for urgent indications (within 12 hours from the onset of clinical manifestations of acute coronary syndrome). The coronarography was performed on the angiographic device INNOVA 3100 (USA) according to the Judkins method using the iodine-contrast agent ultravist. The degree of stenosis of the coronary arteries was determined according to the classification of the American College of Cardiology (ACC) and the American Heart Association (AHA) [1]. The narrowing of the arteries more than 75% considered as hemodynamically significant. An exception was the narrowing of the left coronary artery trunk, where the stenosis more than 50% considered as hemodynamically meaningful. A lesion of more than 75% or stenosis in several vessels distant from the infarct-dependent artery considered as multivessel lesion.

Results

Since that the presence of T2D is a powerful risk factor for adverse effect on the course of myocardial infarction, 79 observed subjects with MI were divided into 2 groups, depending on the presence of type 2 diabetes (**TABLE 1**). The main group included 58 people with type 2 diabetes (23 men and 35 women). The control group included 21 patients without diabetes (10 men and 11 women). In the group with MI and T2D, the predominance of women (60.3%)

Table 1. Baseline characteristics of patients in the main and control groups and indicies of carbohydrate metabolism (M ± m)

Group of patients	Men, No (%)	Woman, No (%)	Age, years	HbA1C,%	Fasting glicemia, mmol/L
IM + T2D, n=58	23 (39, 6%)	35 (60, 3%)	61,43 ± 1,45 *	9,41 ± 0,38 (6,5 to 12,5) *	11,56 ± 0,71 (5,6 to 23,5)
IM without T2D, n=21	10 (47, 6%)	11 (52, 4%)	67,71 ± 1,84	4,8 ± 0,21 (4,1 to 5,1)	-

* - significant difference between the main and control groups (P<0.05);

was noted, which is probably due to the higher prevalence among diabetic women of risk factors such as hypertension and multivessel disease. study of the carbohydrate metabolism status in terms of glycated hemoglobin (HbA1c) and fasting plasma glucose showed that none of T2D patients had an adeqate glycemic control (ie, HbA1c below 6.5% and fasting blood glucose less than 5,5 mmol/L). In most patients, these values exceeded the upper limit of the norm, indicating a decompensation of the carbohydrate metabolism; the average concentration of HbA1c in the main group was 9.41 ± 0.38%, the level of glycemia 11.56 ± 0.71 mmol/L **(TABLE 1)**. The most common lesion in the general group of patients with MI was the injury of the anterior interventricular branch (in 51% of patients), and injury of the left coronary artery (in 2.2% of patients). In the group of patients with T2D (**TABLE 2**), single-vessel lesions were detected in 4 patients (6.8%), lesions in two or more coronary arteries were observed in 27 patients (46.5%). The abcence of hemodynamically significant stenosis in one of the imaged epicardial arteries shown only in 31 (46.4%) patients. Hemodynamically significant lesion of the coronary arteries (stenosis less than 50% and retardment of contrast medium) was noted in 26 patients (46.5%). In the group of patients with MI without concomitant diabetes, the most common lesions were: single-vessel coronary lesions (in 9 patients or 42.8%); multivessel lesion (in 6 patients or 28.5%). Approximately a quarter of patients (in 5 people or 23.8%) had stenosis of the coronary arteries. The retardment of contrast medium was established in 2 patients (9.5%).

The coronaventriculography revealed multivessel lesions of the coronary bed, more frequent lesions were observed in the form of vessel stenosis. In group of patients with T2D, total number of revealed stenoses was 115, compared to the group without diabetes, where the number of detected stenoses was 68 **(TABLE 3).**

In patients with T2D, which occurred prior to the development of MI, severe multivessel coronary lesion was detected in 27 cases (47.4%), while in patients without diabetes, a single vascular lesion was more common (9 people or 42.8%). Lesions of three or more coronary arteries occurred in 38 patients (65.5%) with T2D and in 7 patients (33.3%) without diabetes. The data obtained are consistent with the results of the TIMI and GASS studies [19,20]. Comparison of clinical and angiographic characteristics in patients with MI with single-vessel lesion showed that in a group of 4 patients with newly diagnosed T2D, the proportion of hypertensive patients was 91.1%, which is significantly higher than in a group of 9 patients without a damage of carbohydrate metabolism, in which 77.4% of patients had high blood pressure. Hemodynamically significant narrowing in two or more coronary arteries was detected in 48% of patients with MI and T2D; and a single-vessel lesion was observed less frequently. In patients with T2D simultaneous lesion of several coronary arteries was observed more often comparing with control group. A characteristic feature of coronary atherosclerosis in patients with T2D was the presence of a large number of stenoses located in the proximal and distal part of one vessel. In terms of the degree of stenosing coronary artery lesions, differences were found depending on the glycemic compensation. Thus, in T2D patients, stenoses (115 identified stenoses) and occlusions (46 detected changes) were more frequent than in patients without diabetes (68 stenoses and 19 occlusions). In 20 patients (36%) in the group with T2D, complete occlusions of two or more coronary arteries were revealed. As a result of the conducted studies, it was found that in the group of patients with MI in combination with T2D, multivessel coronary lesion and delay of contrast medium transmission were much more frequent than in patients with MI without diabetes. In the group of patients with multivessel lesion fasting blood glucose level was significantly higher than in patients with a single- vessel lesion.

Table 2. Characteristics of the lesions of the coronary bed in patients with myocardial infarction and type 2 diabetes mellitus and without concomitant diabetes (n,%)

Type of the lesion of the coronary bed	Groups of patients	
	IM + T2D, n=58	IM without T2D, n=21
Single-vessel lesion	4 (6, 8%)	9 (42, 8%)
Lesions in two or more coronary arteries	27 (46, 5%)	6 (28, 5%)
Stenosis less than 50%	7 (13, 7%)	5 (23, 8%)
Retardment of contrast medium	19 (32, 7%)	2 (9, 5%)

Table 3. Frequency of multivessel lesions of coronary vessels of different severity in patients with MI, depending on the presence of type 2 diabetes mellitus according to coronaventriculography data

Groups of patients	Total number of stenoses		Occlusion (stenosis 100%)		Stenosis 76-90%		Stenosis 51-75%		Stenosis < 50%	
	n	%	n	%	n	%	n	%	n	%
IM + T2D, n=58	115	100	46	40,0	13	12,1	21	18,0	35	31,3
IM without T2D, n=21	68	100	19	28,0	28	41,0	12	18,0	9	14,0

Thus, the study revealed the following features of atherosclerotic lesion of coronary vessels in patients with T2D: multivessel stenosis with simultaneous stenosis in several coronary arteries; multiple lesions with stenosis in the proximal and distal parts of one vessel; dominance of hemodynamically insignificant stenoses with a tendency to increase in the number of fully occluded segments. The possible determining factor for the worsening of the course of the IM is not the extent of the narrowing of the coronary arteries, but the instability of the atherosclerotic plaque. In this situation, even with hemodynamically insignificant stenosis, severe myocardial ischemia or acute violation of coronary blood supply can occur. These signs and features of coronary lesions in patients with T2D and MI can explain more severe course of MI with frequent development of coronary complications in this category of patients. The data obtained suggest that there is a correlation between the progression of the vascular lesion of the coronary bed and the concomitant glycemic decompensation.

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