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Aspects of Early Diagnosis of Cardiac Disorders in Children with Type 1 Diabetes

Sadirkhodjaeva Azizakhon Alavitdinovna*, Ashurova Dilfuza Tashpulatovna

Hematology of Tashkent Pediatric Medical Institute, Tashkent, Uzbekistan

Abstract The current problem of children 's cardiology is the study of heart work change in children with type 1 diabetes mellitus (DM 1), as the development of specific heart damage is one of the causes of high mortality of diabetes patients. Heart failure develops in almost 80% of such patients. The main cause of death is cardiovascular complications, among which myocardiodystrophy most often leads to the development of heart failure and sudden heart death. Purpose. To determine the clinical value of the level of MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum in children with type 1 diabetes mellitus and to assess the possibility of use in early diagnosis of cardiovascular complications. Materials and methods study. The total number of patients was 114 children with type 1 diabetes, aged between 4 and 18. We conducted laboratory and instrumental methods of research. Laboratory methods study general clinical (general blood and urine analysis, blood sugar level studies), biochemical (level of total blood protein, bilirubin, cholesterol, triglycerides, creatinine, urea, electrolytes, glycated hemoglobin), cardiology marker (MV B fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein). Conclusion. Thus, markers of cardiac complications in type 1 diabetes mellitus in children can be the MV of the creatine phosphokinase fraction, and the highly sensitive C fraction of the reactive protein, as these factors are reliably increased in the progression of cardiological disorders and can be used as a screening test at the level of the primary health care unit.

Keywords Cardiac markers, Diabetes mellitus, Cardiovascular system, Complication

1. Introduction

The current problem of children 's cardiology is the study of heart work change in children with type 1 diabetes mellitus (DM 1), as the development of specific heart damage is one of the causes of high mortality of diabetes patients. Heart failure develops in almost 80% of such patients. The main cause of death is cardiovascular complications, among which myocardiodystrophy most often leads to the development of heart failure and sudden cardiac death. [12,13]. Currently, the life expectancy of patients remains lower than the average population in the development of DM 1 in childhood [1]. Myocardiodystrophy most often leads to the development of heart failure, diabetic cardiac autonomous neuropathy plays a major role in the development of sudden cardiac death, arterial hypertension leads to the progression of macro- and microvascular complications of DM 1 [4,7]. Various terms ("diabetic cardiopathy," 1 diabetic cardiomyopathy, "diabetic heart", autonomous heart neuropathy, "cardiac autonomous neuropathy", diabetic heart microangiopathy, "specific diabetic heart microangiopathy", proper heart, "myocardiodystomy") are used to refer to the cardiovascular system lesion [2,4,7,9,10,13].

Several pathogenetic mechanisms are involved in the development of cardiovascular disorders in DM 1, the main of which are the diffuse generalized pathological process affecting the whole microcirculation system - microangiopathy with disorders of heart muscle metabolism, changes in nervous regulation of the heart, development of changes within the framework of cardienal syndrome and endothelial dysfunction [6]. Diabetic cardiomyopathy is based on changes in cardiac vessels in the form of microangiopathies, which is accompanied by disorders of microcirculation with morphological and functional changes of myocardium. Microangiopathies are a feature of DM 1 and wear a generalized ha-racter [3]. The main mechanisms in the development of microangiopathies are the processes of pronounced non-enzymatic glycosylation of proteins, collagen, components of the clotting system, hemoglobin, etc., leading to the formation of irreversible substances in chemical reactions, called final product glycosylation [2,10]. An important role in the pathogenesis of diabetic cardiopathy is the activation of lipid peroxidation and the weakening of antioxidant protection, which leads to the accumulation

* Corresponding author:
azizanew@mail.ru (Sadirkhodjaeva Azizakhon Alavitdinovna)
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of potentially toxic products of free fatty acid intermediate oxidation units within myocardiocytes, which have a detrimental effect on myocardial cells [8,10]. Recently, the development of microangiopathies in non-insulin dependent tissues in DM 1 patients is thought to have a genetic predisposition. This explains the fact that not all patients, even in the labile course of DM 1, develop microvascular complications. All the above factors are accompanied by changes in the tone and structure of the vessels of the microcirculatory channel, disruption of the rheological properties of the blood, reduction of the oxygen balance of tissues, disorders of vascular permeability and resistance. These pathogenetic mechanisms of cardiomyopathy formation in children with DM 1 cause myocardiocyte energy deficiency, which promotes development of functional and ultrastructural myocardial changes, being metabolic basis of cardiomyopathy [1,6].

In the genesis of the occurrence of cardiovascular pathology in type 1 diabetes mellitus, along with the development of diabetic microangiopathy and metabolic disorders in the heart muscle, a certain value belongs to the imbalance of vegetative regulation of heart function - autonomous cardiovascular neuropathy. Diabetic autonomous cardiovascular neuropathy is characterized by disorders in the functional state of the cardiovascular system and is one of the main causes of circulatory insufficiency [5,7,8].

One of the reasons for the high risk of cardiovascular complications in children with type 1 diabetes mellitus is the development of atherosclerotic process [1]. The development factors of atherosclerosis are dyslipidemia, AH, endothelial dysfunction and inflammation. In children and adolescents with DM 1, compared to peers without LED, higher levels of lipids are recorded, which are largely dependent on glycemic control. Hyperglycemia and dyslipedemia are also known as pro-inflammatory triggers of neurodegenerative processes [5,8].

The desire to increase the duration and improve the quality of life of diabetes patients has brought to the fore the problem of prevention and treatment of its late complications, the number of which increases with the increase in the duration of the disease.

Aim of the study was to determine the clinical value of the level of MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum in children with type 1 diabetes mellitus and to assess the possibility of using cardiovascular complications in early diagnosis.

2. Materials and Methods

In order to achieve this goal, children hospitalized in the children's departments of the Republican Specialized Scientific Practical Medical Center of Endocrinology in Tashkent were examined.

The work is based on the results of clinical observations analysis in children with type 1 diabetes mellitus and the values of MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum in these patients are investigated. The total number of patients who were studied was 114 children with type 1 diabetes aged between 4 and 18.

Clinical diagnosis in children of type 1 diabetes mellitus was based on the collection of complaints of the patient (dry mouth, thirst, visual impairment), general complaints (fatigue, weakness, insomnia), the history of the disease - the age of diabetes mellitus, aggravated inheritance for diabetes mellitus. During an objective examination of the patient, attention was paid to the general condition of patients, physique, the ratio of height to weight, the condition of skin and mucous membranes, respiratory organs, blood circulation, blood pressure level and pulse rate, and the condition of abdominal organs was assessed.

We conducted laboratory and instrumental methods of research. Laboratory methods study general clinical (general blood and urine analysis, blood sugar level studies), biochemical (level of total blood protein, bilirubin, cholesterol, triglycerides, creatinine, urea, electrolytes, glycated hemoglobin), cardiology marker (MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein).

Methods of the statistical analysis

Statistical processing of the results of the study was carried out using the program Statistica, and Microsoft Excel.

Statistical analysis results could be unreliable ($p > 0.1$), reliable ($p < 0.05$), reliable with high degree of reliability ($p < 0.01$), reliable with high degree of reliability ($p < 0.001$).

3. Results and Discussion

The results of the study of 114 children with type 1 diabetes mellitus, between the ages of 4 and 18, the average age of 12.8, showed that on admission most of the patients had subcompensation of diabetes mellitus and presented characteristic complaints of the main disease.

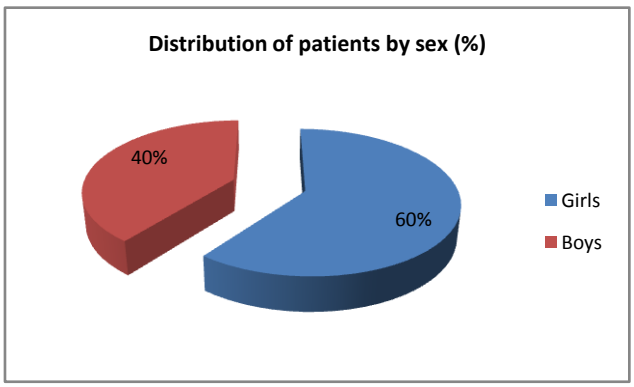

Figure 1. Distribution of patients by sex

Research work was carried out in the Children's department of the Republican Specialized Scientific

Practical Medical Center of Endocrinology in Tashkent. 114 children with type 1 diabetes were included in the survey. At the time of the examination, none of the children had ketoacidotic and hypoglycemic conditions. Depending on the duration of the disease, all children were divided into three groups. The first group consisted of 72 children with a DM duration of less than 5 years (63%), the second group - 42 children with a disease duration of more than 5 years (37%). The control group was 30 healthy children, comparable to sick children by sex and age.

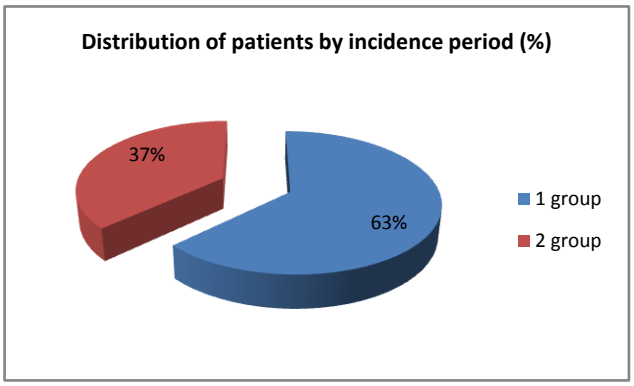

Figure 2. Distribution of patients by incidence period

In further analysis of the obtained data depending on severity of diabetes mellitus of 1 type in children in 104 children (91.3%) there was a moderate severity of course and in 10 children (8.7%) there was a severe course of this disease.

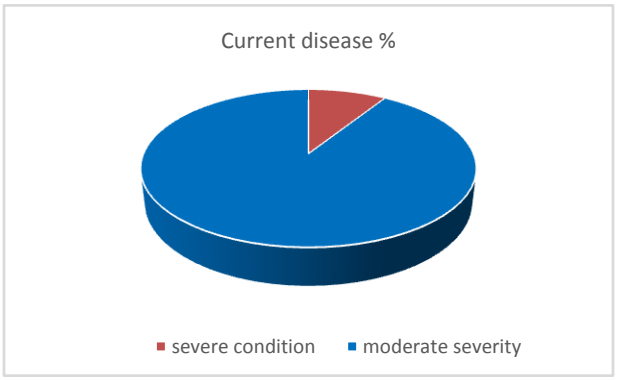

Figure 3. Current disease

Among all late complications, retinopathy (8 children, 7%), peripheral sensory-motor polyneuropathy (59 children, 52%), encephalopathy (23 children, 20.7%), and hyropathy (25 children, 21.9%) were the most frequently detected. Quite rarely - nephropathy, it was detected (2 children, 1.7%). It has been established that only in case of prolonged and severe course of disease nephropathy was diagnosed (2 children, 1.7%). The increase in the incidence and severity of complications against the background of the increase in the duration of diabetes mellitus indicates a deepening of metabolic-dystrophic changes and a breakdown of adaptation in the body of the sick child.

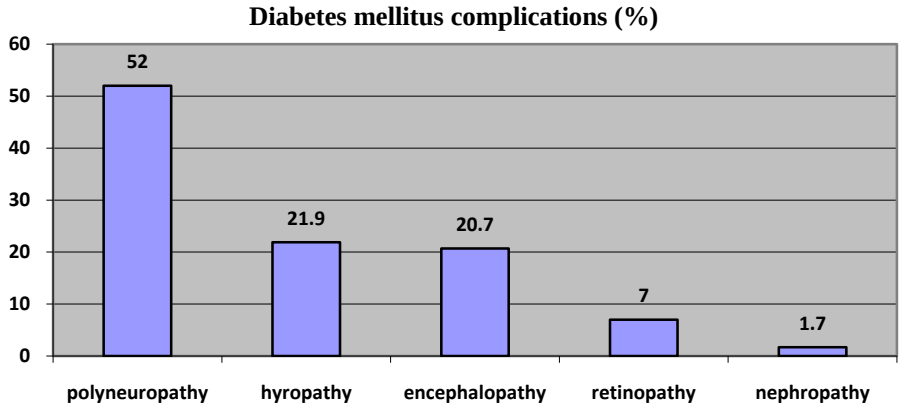

Figure 4. Diabetes mellitus complications

Of the concomitant diseases, 47 children were most often diagnosed with type 1 diabetes mellitus (41.2%), retinal angipathy in 9 children (7.8%), moipia in 4 children (3.5%), autoimmune thyroiditis in 7 children (6.1%), chronic cholecystitis in 5 children (4.3%), chronic pyelonephritis in 2 children (1.7%) systemic lupus in 2 children (1.7%), juvenile rheumatoid arthritis in 1 patient (0.87%), celiac disease in 1 patient (0.87%) vegetative dysfunction syndrome in 2 children (1.7%) autoimmune thyroiditis in 7 children (6.1%).

For early diagnosis of the debut of diabetic cardiomipathy, we used cardiac markers such as the MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum.

As a result of the study, it was found that most children with diabetes have an increase in the cardiological marker in the biochemical blood analysis. Including MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein.

By studying the indicator of glycated hemoglobin in children with diabetes mellitus is the development of late complications of diabetes mellitus in children, including from the cardiovascular system, there are metabolic disorders associated with unsatisfactory compensation of the disease, which, according to our data, is out of control with

the duration of diabetes mellitus more than 5 years. This is confirmed by a close direct correlation of the HbA1c level with the duration of the disease.

Table 1. Lipidic range of blood

Indicator	1 g	2 g
HbA1c	10,22%	10,67%
Total cholesterol	4,2 mmol	4,3 mmol
Triglycerides	1,3 mmol	1,6 mmol
High density lipoproteins	1,4 mmol	1,8 mmol
Low density lipoproteins	3 mmol	9,4 mmol

Considering the above-stated data duration of a disease and the HbA1c level as indicator of a metabolic imbalance rather reliably correlates with organ and system complications. It can be assumed that the leading importance in the development of organ pathology is not the maximum peaks of blood glucose concentration rise, but the long-lasting hyperglycemia.

The following data were obtained from the comparative analysis. The first group of 72 children (63%) the average level of cardiac markers of MV creatine phosphokinase was 32mg/l, the highly sensitive C fraction of the reactive protein 5.2g/l, glycated hemoglobin 10.22%, total cholesterol content 4.2 mmol, triglycerides 1.3 mmol, high density lipoproteins 1.4 mmol, low density lipoproteins 3 mmol.

The second group of 32 children with 1 tapa diabetes mellitus (37%) the average level of cardiac markers of MV creatine phosphokinase was 28 mg/L, highly sensitive fraction of SRB 0.9 g/L, glycated hemoglobin 10.67%, total cholesterol content 4.3 mmol, triglycerides 1.6 mmol, high density lipoproteins 1.8 mmol, low density lipoproteins 9.4 mmol.

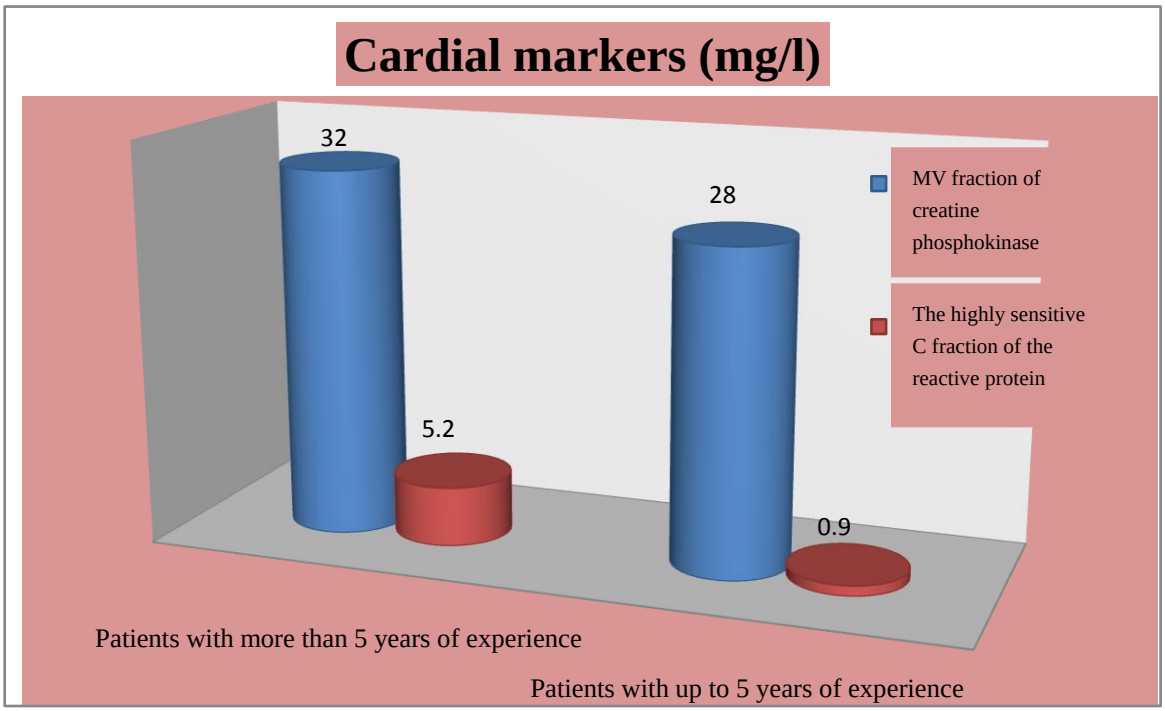

Figure 5. Cardiac markers depending on seniority disease

Table 2. Echocardiographic change of heart depending on an experience a disease of DM of 1 type

Diagnosis Echo Cardiogram	Total 114(100%)	Duration of the disease up to 5 years 72(63%)	Duration of the disease more than 5 years 42(37%)
Lack of structural changes	41(36%)	36(50%)	5(12%)-
Mitral regurgitation	30(26%:)	9 (12,5%0	21 (50%)
Seals of mitral valve doors	16(14%)		16(38%)
Insufficiency of the mitral valve	5 (4,3%)		5(12%)
Thickenings of the interventricular partition	5 (4,3%)		5(12%)
Hypertrophy of a left ventricle	30 (26%)	9(12,5%)	21950%)
Sinus tachycardia	23(20%)	18(25%)	5(12%)

Thus, from the point of view of the given literary data, and the results obtained by us suggest that the content of the index of cardiac markers MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein is observed in case of longer course of diabetes mellitus and progression of cordial disorders.

When the heart was examined in Echo Cardiogram in 41 patients (36%), there was no structural change. In 30 patients (26%), mitral regurgitation was found. In 16 patients (14%), the walls of the mitral valve are sealed. In 5 patients (4.3%), mitral valve failure was detected. In 5 patients (4.3%), thickening between ventricular septum. 30 (26%) patients showed left ventricle hypertrophy. In 23 (20%) patients, sinus tachycardia was found. This indicates a compensatory response to metabolic and circulatory disorders, an increase in heart size and subsequent dilation of heart muscles. But muscle dilation occurs at DM duration of more than 10-15 years and depends on the degree of compensation and on the therapy performed.

Thus, the complication of DM is a major pediatric problem, which does not close only to dialectologists, but also requires the attention of pediatricians, nephrologists, cardiologists, neuropathologists, etc., of lesions of the cardiovascular system, micro- and macroangiopathy both in frequency and in determining influence on the state of all organs and systems, including the heart, take the first place.

Cardiomyopathy in DM has a complex genesis. Myocardial change in DM is an indicator of dysmetobolism characterizes the general course of diabetes, largely determines the quality of life, the outcome of the disease. At the same time, an important place is taken by the dysfunction of LV, which is explained by many reasons, for example: such as poor control of glycirannous hemoglobin, arterial hypertension, duration and course of the disease, etc.

Therefore, issues of early diagnosis in children of beginning pathological processes, long before their clinical manifestations, are very relevant.

One of the most informative and accessible methods for the diagnosis of heart injury in DM is the Echo Cardiogram, which allows the diagnosis of functional changes and processes of heart muscle remodeling.

All the above proves the need to study changes in the cardiovascular system in children of type 1 DM.

Thus, markers of cardiac complications in type 1 diabetes mellitus in children can be the MV fraction of creatine phosphokinase fraction, and the highly sensitive C fraction of the reactive protein, since these factors are reliably increased in the progression of cordial disorders and can be used as a screening test at the level of the primary health care unit.

Cardiac complications of diabetes mellitus are detected when patient complaints or objective data are available. This diagnosis is not early. From our point of view, it was advisable to develop the main directions of screening of patients with initial stages of cordial complications for timely diagnosis.

4. Conclusions

1. The MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum in children with type 1 diabetes are correlated with the duration and severity of the disease.
2. The index MV fraction of creatine phosphokinase and the highly sensitive C fraction of the reactive protein in blood serum in children with type 1 diabetes mellitus can be used as an additional diagnostic criterion in the early stages of cardiovascular complications of diabetes mellitus.

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