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CRITERIA FOR ASSESSING FORENSIC MORTALITY IN CHILDREN WITH TYPE 1 DIABETES MELLITUS

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Abstract. *The methods of posmortal diagnosis of diabetes mellitus are offered to put into forensic medical practice, that allow, at the result of complex cadaver's examination (analysis of the most informative signs, being typical for this pathology), and, biochemical studies (analysis of glycemic hemoglobin, creatinine, urea), samples of cadaver's blood, to make a conclusion on presence diabetes mellitus as the main cause of death, or, associated disease.*

Keywords: *posthumous diagnosis of diabetes, hemoglobin, creatinine, urea.*

Relevance

In recent years, there has been a sharp increase in the incidence of diabetes mellitus (DM) worldwide. At the same time, the number of DM patients doubles every 10-15 years. According to the data of the Ministry of Health of the Republic of Uzbekistan, diseases of the cardiovascular system in combination with diabetes occupy a leading place in the structure of mortality.

Diabetes mellitus leads to early disability and mortality, which are primarily caused by macro- and microangiopathic complications: atherosclerosis and coronary heart disease, nephropathy, retinopathy, neuropathy and osteofibropathy [1, 2, 6, 9]. Diabetic angiopathies are the most common cause of death – up to 80% of patients with DM [4, 8].

It should be noted that in these cases, sudden death is most often noted, in which the corpse is subject to mandatory forensic medical examination, primarily to exclude violent death.

At the same time, DM in a postmortem diagnosis (as the main or concomitant pathology) is extremely rare. Apparently, this is due to the fact that the pathomorphological diagnosis of diabetes as the main cause of death is associated with a number of difficulties, namely:

- underestimation of DM as the main cause of death by forensic experts;
- the absence of medical documents from forensic experts about the lifetime state of health of the deceased (outpatient card, medical history, etc.);
- the absence of pathomorphological signs specific to DM;
- the lack of a methodology for examining corpses in cases of sudden death, which makes it possible to detect the presence of diabetes mellitus with great reliability.

A significant difference between morbidity rates, data on mortality from complications of diabetes and the frequency of occurrence of a postmortem diagnosis of diabetes mellitus in the forensic medical examination of corpses indicates the presence of many unresolved issues of postmortem morphological diagnosis of diabetes, including as the main cause of sudden death.

Currently, in forensic medical practice, the diagnosis of "Diabetes mellitus" is made on the basis of a number of available morphological signs and the results of additional studies. The signs of DM described in textbooks on pathological anatomy are not detected in all cases in real expert practice, besides they do not have pathognomonicity.

There are a number of papers that contain recommendations for the diagnosis of DM by biochemical parameters of cadaveric blood [3, 5, 7], but they also need to be evaluated only in a

complex. At the same time, the concentration of glucose in the blood is considered as the main indicator.

The developed method for determining glycated hemoglobin in samples of liquid cadaveric blood and in its samples from a dry spot [5, 9] has not been widely used in forensic medical practice.

It should also be noted that in order to identify biochemical blood parameters, it is necessary to send cadaveric blood samples for additional biochemical studies. However, this happens extremely rarely (only with commission examinations), because forensic medical examinations are not focused on the detection of DM and, in the absence of a biochemical laboratory as part of the bureau of forensic medical examination.

Thus, making a forensic diagnosis of "Diabetes mellitus" or "Diabetic coma" presents significant difficulties. This, in our opinion, is due to the fact that to date there are no clear and specific scientifically based recommendations for establishing a post-mortem diagnosis of diabetes mellitus.

The purpose of the study. Development of scientifically based recommendations and algorithm for post-mortem diagnosis of diabetes mellitus in forensic medical practice.

Materials and methods of research

The material for our research were:

- blood samples taken from the corpses of persons who died a violent and non-violent death (45 cases);
- archival materials (acts of forensic medical examination of corpses; 51 cases in total);
- corpses of persons who died suddenly (38 cases).

Biochemical studies (mainly on the content of glucated hemoglobin) were checked at the Department of Biochemistry of the Tashkent Pediatric Medical Institute.

When analyzing the "Expert Conclusions" and "Acts of forensic medical examination of a corpse" in the RNPTSME, we took into account more than 88 signs, which can be divided into the following groups:

1. General signs – age, gender, prescription of death, brief circumstances of death.
2. External signs – appearance, body weight and size, skin color, cadaveric phenomena.
3. Internal signs – macroscopic and microscopic (results of forensic histological examination).
4. Forensic medical diagnosis and expert conclusions.

In all cases, there were more men (72.8%) than women.

For biochemical studies, cadaveric blood samples were taken from the corpses of persons who died within 24 hours.

Morphological and biochemical parameters were systematized and compiled into a single table by the coding method.

The following research methods were used in the work:

- photometric determination of the relative content of glycated hemoglobin (HbAlc) in cadaveric blood;
- determination of the amount of blood glucose by enzymatic glucose-peroxidant method;
- determination of creatinine by the Popper method;
- determination of urea concentration by diacetyl monooxime method;
- morphometric method;

- methods of statistical analysis (discriminant analysis).

The results of the study and their discussion

All selected cadaveric blood samples were examined for the content of glycated hemoglobin. The content of glycated hemoglobin in 48.2% of cases exceeded the norm.

When analyzing archival material, it was revealed that in 86.3% of the total sample, DM was not diagnosed during a forensic medical examination, of which, in 42.6%, DM was not diagnosed during life (data were not available in medical documents).

Our observations of the level of glycated hemoglobin were distributed as follows (Table 1).

The concentration of glycated hemoglobin over 12% indicates decompensation of DM, clinically manifested by hyperglycemic coma. As the causes of death, "Hyperglycemic coma, diabetes mellitus" in our observations occurred in one case when this diagnosis as a concomitant was indicated in the medical history.

Table 1.

Distribution by level of glycated hemoglobin in cadaveric blood samples

Уровень HbAlc	Compensation stage	Number of cases (in %)
5,5-7,9%	Well compensated	41
8-9,9%	Sufficiently compensated	28
10-11,9	Partially compensated	21
12% и более	Decompensation	11

Next, we determined the levels of glucose, urea and creatinine in cadaveric blood samples from the obtained sample (with an increased level of diabetes mellitus). At the same time, the following spread of data presented in Table 2 was obtained.

Table 2

Concentrations of biochemical parameters in cadaveric blood samples

Concentration	Glucose	Urea	Creatine
Lowered	25	11	22
Norm	17	86	52
Increased	138	82	106
Was not carried out	0	1	0

In 73.4% of cases, increased levels of urea and creatinine were observed, which indicates nephrotoxic syndrome, which itself is a complication of diabetes and can contribute to the onset of death.

An increase in creatinine concentration against the background of the maximum concentration of urea is a sign of renal insufficiency.

All archival material was evaluated according to signs, of which there were more than 100, but in the process of primary statistical processing, 30 of the most informative morphological signs were identified – the most essential for the study of diabetes mellitus (Table 3).

To verify the correctness of the conclusions, we introduced a control group (those who died a violent death with the level of glycated hemoglobin within the normal range).

Table 3.

Morphological features characteristic of DM and their encoding variants

Sign	Evaluation options	Encoding
1	**2**	**3**

Food	sharply lowered lowered somewhat lowered satisfactory slightly elevated elevated sharply elevated	0 1 2 3 4 5 6
Vessels of the brain	thin, elastic, thickened, dense, convoluted	1 2 3
Thickness of subcutaneous adipose tissue at the navel level	value in centimeters	
Heart Size	reduced norm increased	0 1 2
Heart mass	reduced norm increased	0 1 2
The severity of fat deposits under the endocardium	small moderate abundant excessive	1 2 3 4
Myocardial density	dense somehow dense flabby somehow flabby	1 2 3 4
The color of the myocardium on the incision	encoded by the spectrum	
Focal myocardial changes	No Yes	0 1
Small - focal myocardial changes	No Yes	0 1
Uneven blood filling of the myocardium	No Yes	0 1
Wall thickness of the left ventricle	value in centimeters	
Wall thickness of the right ventricle	value in centimeters	
1	**2**	**3**
The presence of atherosclerotic changes in the coronary vessels (narrowing of the vessel lumen)	no up to 30% up to 50% up to 75% up to 90%	0 1 2 3 4

The presence of atherosclerotic changes in the aorta	No Yes	0 1
Liver Size	Normal increased	1 2
Liver mass	normal increased	1 2
The edge of the liver	rounded pointed	1 2
Liver color on the incision	encoded by the spectrum	
The presence of pathological changes in liver tissue	no nodes areas of yellowish color yellowish tint small whitish inclusions flabbiness of parenchyma greasy appearance nutmeg liver blurring of the pattern mottled appearance	0 1 2 3 4 5 6 7 8 9
Length of the pancreas	the norm reduced	1 2
Width of the pancreas	the norm less	1 2
Thickness of the pancreas	the norm reduced	1 2
Gland density	flabby somehow flabby elastic (tightly elastic) unevenly compacted compacted dense sharply compacted	0 1 2 3 4 5 6
The color of the gland on the incision	encoded by the spectrum	
The structure of the gland on the incision	the lobulation is smoothed fine-lobed lobed (medium-lobed) large-lobed	0 1 2 3
1	**2**	**3**
The presence of pathological changes in the gland	no whitish layers areas of adipose tissue in the stroma greasy shine abundantly overlaid with fat	0 1 2 3 4

	calcinates swelling capsules cysts	5 6 7
The presence of hemorrhages in the gland	no vessels are dilated, hemorrhages are full-blooded	0 1 2

Next, we carried out statistical processing of the data obtained with the derivation of the discriminant function. This function allows you to assign each new case under study to one of 2 groups - observations with DM and a control group.

Thus, using this function, we were more likely to establish a postmortem diagnosis of DM by biochemical and pathomorphological changes.

The most significant signs identified during the sectional study were the following:

- degree of fatness;
- severe atherosclerosis of the cerebral vessels;
- increase in the mass and size of the heart;
- macroscopic signs of cardiomyopathy (color and uneven blood filling of the myocardium, the presence of small-focal cardiosclerosis);
- pronounced atherosclerotic changes of the coronary vessels and aorta (II-IV degrees);
- color (presence of brown and yellowish shades) and pathological changes in liver tissue (nodes, inclusions, flabbiness of parenchyma, muscat liver);
- pathological changes in pancreatic tissue (whitish layers, areas of adipose tissue in the stroma, calcinates, cysts).

A formula has been developed that allows, according to a set of macroscopic signs, to establish the presence of DM in each case with a probability of more than 80%. This probability is statistically significant for medicine in general and forensic medicine in particular. We believe that such a statistical calculation can serve as a tool for forensic medical experts in the post-mortem diagnosis of diabetes mellitus.

For the final verification of the diagnosis of "Diabetes mellitus" or "Diabetic coma" and determining its degree of compensation, it is necessary to conduct biochemical studies of cadaveric blood samples for the concentration of glycated hemoglobin. To identify complications of the disease (primarily renal failure), it is necessary to conduct a biochemical study of cadaveric blood for creatinine and urea.

Conclusions:

1. The frequency of occurrence of elevated levels of glycated hemoglobin in cadaveric blood samples is quite high, which indicates a large proportion of undiagnosed diabetes mellitus during life.

2. Analysis of archival material of forensic medical reports revealed that the diagnosis of "Diabetes mellitus" or "Hyperglycemic coma" as the main cause of death was not exposed when making a forensic medical diagnosis.

3. The most informative pathomorphological signs characteristic of diabetes mellitus have been identified, which can serve as the main tool for complex postmortem diagnosis.

4. An increased level of glycated hemoglobin is a reliable biochemical criterion for postmortem diagnosis of diabetes mellitus.

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