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Gestational Diabetes Mellitus

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Abstract. Data from a comparative analysis of specific diagnostic symptoms in GDM in pregnant women, for a detailed description of changes in the body of a pregnant woman with GDM, we studied the concentration of homocysteine in the blood for comparison in two study groups - 36 healthy and 68 pregnant women with GDM. According to the analysis of blood in the case histories of patients in groups, anemia was observed in an average of 61.45% of patients.

Based on the above data, using the Microsoft Excel 2010 program, a series of variations was built to find M±m indicators of the degree of dependence of these features, their correlation levels were studied by the Spearman method.

Homocysteine is a biomarker that controls the action of folic acid in the body in pregnant women, the reference values of which are in the range of 5.6–16.42 µmol/l, while in healthy women this diagnostic indicator averages 12.98 ± 0.31. The mean homocysteine value in pregnant women with GDM was 42.87±2.26 µmol/l (P≤0.001).

Another specific marker in pregnant women with GDM is the study of cholecalciferol, vitamin 25(OH) D.

Investigating the concentration of vitamin 25 (OH) D in the blood of pregnant women with GDM, it was found that its concentration decreased to an average of 24.7±0.43 ng/ml, while in healthy women it was 32.3±1.4 ng/ml and it was found that the level of significance of the difference between the indicators in the group of pregnant women with GDM and in the control group was p<0.001, i.e. almost 2 times less. Reference values for the presence of cholecalciferol varied in the range of 30–100 ng/ml. This means that 7 healthy pregnant women out of 36 without GDM had low levels of 25(OH) D vitamin and these were grade 1 obese pregnant women.

***Key words*:** homocysteine, 25(OH) D, leptin, C-peptide, pregnant with diabetes, blood glucose

Gestational diabetes is a type of diabetes that can develop during pregnancy in women who don't already have diabetes[1,7,18].

Numerous studies are being conducted around the world to optimize the prevention of gestational diabetes, as well as the search for accurate biomarkers, early screening and prevention of gestational diabetes in the field of obstetrics and gynecology[2,12,16].

Early diagnosis of the development of gestational diabetes and the appointment of effective treatment and prevention is an urgent problem for specialists in many areas. The results of the proposed study suggest that gestational diabetes is a direct risk factor for the development of perinatal complications, such as a large fetus, an increase in operative and premature births, the development of gestational hypertension and preeclampsia, and hypoglycemia in the infant. Among the obstetric complications of gestational diabetes, the state of hyperglycemia is of particular importance[3,11,17].

Today, gestational diabetes is a metabolic disorder characterized by impaired insulin resistance that initially occurs during pregnancy. The incidence of gestational diabetes increases in parallel with weight gain and mainly malnutrition. The problems of screening and prevention of gestational diabetes today create many unpleasant consequences, so the

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improvement of laboratory algorithms based on the analysis of biochemical and enzyme immunoassay markers will help resolve a number of issues in this area[5,10,15].

Epidemiological data show that the incidence of gestational diabetes among pregnant women is increasing, and the prevention and screening of this disease is one of the most urgent problems that many areas face today. In our country, today there are no standards for early screening for GDM that could fully justify itself, and current issues such as early detection and prognosis have not been fully resolved. Currently, the mechanisms of the origin of GDM are not well understood, and therefore, scientific research is underway to identify early screening biomarkers associated with GDM [4,9,13-45]. However, the interaction of identified markers with overt and latent clinical signs of GDM has not been clearly demonstrated. For this reason, the search for predictors of GDM and complications is relevant [6,8,14].

It is also necessary to develop models for effective detection of women with gestational diabetes, timely screening and prevention methods, which are of particular importance in the management of gestational diabetes and help improve health outcomes. GDM is not a cure, but prevention is a priority in terms of both health and economics. In a non-diabetic woman at risk of GDM, even a small decrease in glucose levels can be an important factor for pregnancy and the health of future generations.

The aim of the work is introduction of screening methods based on clinical laboratory and symptoms in the early diagnosis of gestational diabetes.

Materials and methods: The study included biochemical (homocysteine, glucose, creatinine, glycated hemoglobin), hormonal (leptin, C-peptide, 25 (ON) D, methods of correlation and statistical research.

Results and discussion: Glycated hemoglobin or glycohemoglobin (HbA1s) is a blood biochemical marker that reflects the amount of glucose in the blood over a long period (three to four months), in contrast to blood glucose measurement, which only gives an idea of blood glucose levels for moment of testing.

In general, in our pregnant women with GDM, it averaged 7.7% before delivery, which corresponds to the normative data, but it should be noted that in healthy women this figure dropped significantly to 3.2%.

The high level of HbA1 compared with healthy pregnant women can be explained by the high level.

The amount of glycated hemoglobin administered for the diagnosis of GDM varied on average from 9.36±0.36 to 3.89±0.11 ng/ml in pregnant women with GDM and in the control group. Given these changes, we decided to analyze the indicator in D-dimer, in case of detection of hypercoagulability, add low molecular weight anticoagulants to correct coagulation disorders in the hemostasis system.

Another specific marker in pregnant women with GDM is the study of cholecalciferol, vitamin 25(OH) D.

Investigating the concentration of vitamin 25 (OH) D in the blood of pregnant women with GDM, it was found that its concentration decreased to an average of 24.7±0.43 ng/ml, while in healthy women it was 32.3±1.4 ng/ml and it was found that the level of significance of the difference between the indicators in the group of pregnant women with GDM and in the control group was $p<0.001$, i.e. almost 2 times less. Reference values for the presence of cholecalciferol varied in the range of 30–100 ng/ml. This means that 7 healthy pregnant women out of 36 without GDM had low levels of 25(OH) D vitamin and these were grade 1 obese pregnant women.

Thus, lower levels of vitamin 25(OH)D are associated with reduced insulin sensitivity and may contribute to a number of complications such as fetal growth retardation,

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undetermined fetal status, and antenatal fetal death in pregnant women with GDM. It is the initial deficiency of 25(OH)D vitamin in pregnant women with GDM that can aggravate the state of the body, contribute to the disruption of blood microcirculation, with a subsequent violation against the background of already formed hypercoagulability.

In the seventh section of the dissertation, "Assessment of the condition of the fetus using ultrasound in GDM", ultrasound Doppler was performed to assess the condition of the amnion fluid index (AVI), fetometry and placenta using ultrasound examination. In the control group, when studying IAV, polyhydramnios was not observed, 49.3% of 33 pregnant women with a history of GDM complications were observed, and 27.9% of 19 pregnant women with developed GDM.

Homocysteine is a biomarker that controls the action of folic acid in the body in pregnant women, the reference values of which are in the range of 5.6–16.42 μmol/l, while in healthy women this diagnostic indicator averages 12.98 ± 0.31. The mean homocysteine value in pregnant women with GDM was 42.87±2.26 μmol/l (P≤0.001).

In 68 pregnant women with pre-existing obesity with GDM, there was a mean change of 16.74 ± 0.28 ng/ml, however, high leptin levels were observed even before pregnancy, indicating that they had high leptin levels before the antenatal period, which indicated the presence of metabolic syndrome in this contingent.

In 5 of the group of healthy pregnant women, obesity of the 1st degree was observed, and the leptin index also varied within 7.9±0.32 ng/ml, i.e. there was a slight increase in obesity.

The D-dimer marker, which determines the coagulation status of the body, averaged 1796±18.76 ng/ml in pregnant women with gestational diabetes and 814.6±33.3 ng/ml in the comparison group.

To identify placental and fetal circulatory disorders associated with the development of complications, we also studied specific analyzes in dynamics, such as homocysteine, leptin, C-peptide, D-dimer and 25 (OH)D. When septic complications occurred, the following indicators were included in the studies as C-reactive protein and procalcitonin.

To determine the time of onset of GDM, it is important to know the level of glycosylated hemoglobin in pregnant women while performing a glucose tolerance test.

Many biochemical tests and fasting blood glucose are performed at the primary care level and are considered routine laboratory tests.

Laboratory tests such as complete blood count, hemostasiogram, and assessment of biochemical abnormalities can characterize the true state of obstetric complications that are also present in GDM.

To prevent complications of GDM, i.e. to detect fetal growth retardation syndrome (SORP) as a result of large fetuses, macrosomia, diabetic fetal fetopathy (DFP), fetometry was performed in pregnant control groups using Mindray-50 ultrasound equipment to prevent complications of GDM, i.e. to detect fetal growth retardation syndrome as a result of large fetuses, macrosomia, diabetic fetal fetopathy (DFP), fetometry was performed in pregnant control groups using Mindray-50 ultrasound equipment.

The results of our studies also revealed cases of malnutrition, the main cause of which was a reversible process in the arteries and veins of the satellite circulatory system of the placenta. The presence of varying degrees of preeclampsia in almost all pregnant women with fetal growth retardation syndrome has proven that there is an association between GDM and preeclampsia.

In the group of healthy pregnant women, cases of asymmetry and antenatal fetal death were not observed. In pregnant women with GDM, cases of antenatal fetal death were observed in 34.3% and 2.94% of patients with a history of GDM, respectively.

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As a result, in terms of age, most pregnant women with GDM and women with a history of GDM were between 20 and 29 years of age. The incidence rate was also higher in older pregnant women than in the control group.

When asked by the history taking method, whether close relatives of pregnant women with GDM had inherited diabetes mellitus, where cases of DM were diagnosed (58.2% of pregnant women with a history of GDM, 57.4% of patients with GDM).

When studying the state of somatic diseases of pregnant women in the study groups in pregnant women with a history of GDM and GDM, chronic pyelonephritis occurred in 32.8% and 30.9%, thyroid disease in 32.8%, 35.3%, obesity - 75% and 64.2% in two groups, respectively.

According to the analysis of blood in the case histories of patients in groups, anemia was observed in an average of 61.45% of patients.

Based on the above data, using the Microsoft Excel 2010 program, a series of variations was built to find M ± m indicators of the degree of dependence of these signs, their correlation levels were studied by the Spearman method (Table 1).

Table 1

Levels of clinical and anamnestic dependence of pregnant women with GDM

Indicators	M±m	Correlation dependence	
		R	Degree
Age ≥ 29	30±0.62	0.4	Correct Average
Obesity BMI ≥ 30	31.71±0.8	0.84	Proper strong
Overweight BMI ≥ 25	27±0.54	0.6	Correct Average
Diffuse goiter	0.35±0.06	0.5	Correct Average
DM hereditary predisposition	0.6±0.06	0.96	Proper strong
Chronic pyelonephritis	0.5±0.061	0.3	Proper weak
History of antenatal death	0.56±0.06	0.7	Proper strong
Polyhydramnios	0.7±0.06	0.6	Correct Average
Preeclampsia	0.5±0.06	0.78	Proper strong
Large fruit ≥ 4 kg	0.95±0.025	0.87	Proper strong

Note: * P ≥0.05 - a significant difference compared to the control group.

Thus, the degree of correlation dependence of these factors served as an auxiliary scale for assessing pregnancy in women with GDM.

In our studies, we compared such markers as - (homocysteine, 25 (OH) D, leptin, C-peptide, HbA1c, D-dimer, PGTT, FPTT, C-reactive protein) and determined the degree of correlation between pregnant women with GDM and healthy pregnant women of the control group. As a result, it was found that the correlation between homocysteine (0.76), leptin (0.78), C-peptide (0.81) and OGTT (0.9) in the study had a degree of correct strong correlation.

Table 2

The degree of correlation dependence of laboratory tests.

No.	Analyzes	M±m	R	r	Correlation level _ _ _
1.	**Homocysteine**	**42.4±2.3**	**p<0.001***	**0.76**	**Proper strong**
2.	**25 (OH) D**	**24.6±0.4**	**p<0.001***	**0.65**	**Correct Average**

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3.	Leptin	16.6±0.3	p<0.001*	0.78	Proper strong
4.	C-peptide	4.9±0.2	p<0.001*	0.81	Proper strong
5.	HbA1 with	12.6±0.5	p<0.001*	0.52	Correct Average
6.	D- dimer	1796 ±18.8	p<0.001*	0.52	Proper weak
7.	OGTT (on an empty stomach)	10 ±0.3	p<0.001*	0,9 _ _	Proper strong
8.	APTT	30.6 ±3.6	p<0.005*	0.56	Correct Average
9.	C-reactive protein	5.9 ± 0.3 1	p>0.05 *	0.28	Proper weak

Correlation correct average levels of communication were determined between such laboratory indicators as -25 (OH) D (0.65), HbA1c (0.52), FPTV (0.56). The coagulogram index D-dimer has the correct level of weak correlation with such a sepsis marker CRP (Table 2).

Thus, on the basis of clinical and anamnestic data, laboratory indicators, it was proved that the results of the analysis in the early diagnosis and screening of GDM play an important role in predicting the course of pregnancy and the development of possible complications.

Conclusions:

1. In our studies, the risk factors for the development of gestational diabetes were: obesity of the 1st degree (43%), 2nd degree (21.5%) and overweight (12%), women with hereditary diabetes mellitus (57.4%), the presence of a large fetus history (80.9%), preeclampsia (66.2%), polyhydramnios (35.3%), with a condition after COVID-19, complicated by transient diabetes (14.7%,).
2. The negative impact of gestational diabetes on both the mother's body and the fetus, with the subsequent development of DF and insulin resistance of the fetus. They were reflected in the following indicators: an increase in the level of glycated hemoglobin (HbA1c) by 2–2.3 times, insulin resistance of hormonal indicators to C-peptide by 92.4%, homocysteine (a marker of folate status) by 12% and an increase in the predictor of metabolic leptins on average 65% (p<0.001) of the LDH level, LII by 10% relative to the reference values.
3. To prevent complications in the mother and fetus, based on clinical and laboratory data and predictors of the development of gestational diabetes mellitus (C-peptide, leptin, an increase in BMI up to 450 mg up to 20 weeks, 1.5 times more than normal pregnancy) indicates a complicated course of GDM and Insulin dose adjustment should be immediately introduced together with an endocrinologist; in order to prevent maternal and perinatal complications, an algorithm based on a computer program has been optimized.

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Website: https://academiaone.org/index.php/2

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