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Role of Excess Body Weight and Obesity at Mother in Formation of a Macrosomia of the Newborn

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Abstract

Objective: To define risk of formation of a macrosomia newborn at pregnant women with obesity and excess body weight.

Research objective was determination of risk of formation of a macrosomia at pregnant women with obesity and excess body weight. The prospektivny controlled research in which have been included is conducted 754 patients. The 1 group has included 262 patients with obesity, the average body mass index (BMI) 33,1 (31,4; 35,9) kg/sq.m, at the age of 30 (27; 34) years. Group 2 the 260th patients with excess body weight have made, the average BMI 27,5 (26,4; 28,7) kg/sq.m, at the age of 29 (25; 33) years. 232 patients with normal body weight, the average BMI 22,6 (21,0; 23,8) kg/sq.m have entered into the 3rd group (control), at the age of 28 (25; 31,5) years. Assessment of anthropometrical data, a research of koagulotest, assessment of lipidic and carbohydrate exchanges, an ultrasonic fetometriya and a dopplerometriya was carried out.

Results: On the basis of results of logistic regression of continuous signs the predictive model which can significantly predict probability to 70,3% of the birth of the large child is constructed and will allow to avoid perinatal complications.

Keywords: Obesity; Excess body weight; Gestational diabetes; Large newborn; Lipidic exchange

Introduction

Within the last 7 years extragenital diseases strongly take the I place in structure of the reasons of maternal mortality, in 2009 their share has reached a maximum – 50% [1-4]. In this regard the interest of researchers in a problem of excess body weight and obesity at pregnant women has considerably increased [1,5-10]. Growth of prevalence of obesity has around the world reached that level when its began to consider as one of the most significant problems of the 21st century. There is an opinion that pregnant women with obesity enter into risk group on development of a preeclampsia, massive obstetric bleedings, placentary insufficiency, a macrosomia and other complications (a pelvic dispoportion, maternal and perinatal trauma and setera) [10-15]. At the same time the probability of the birth of a large newborn depends on many factors in this connection the relevance of a research doesn't raise doubts.

Materials and Methods

The research has included 754 patients. The 1st group was made by 260 patients with obesity at the age of 30 (27; 34) years which had an average body mass index (BMI) 33,1 (31,4; 35,9) kg/sq.m. The group 2 was made by 262 patients with excess body weight with the average BMI 27,5 (26,4; 28,7) kg/sq.m, at the age of 29 (25; 33) years. 232 patients with normal body weight at the age of 28 have entered into the 3rd group (25; 31,5) years with the average BMI 22,6 (21,0; 23,8) kg/sq.m.

Criteria of inclusion in a research

- Obesity at the pregnant woman (for 1 and 2 groups);

- Lack of a decompensation the extragenital diseases (for all groups);

- Consent to participation in a research (for all groups).

Criteria of an exception (for all groups)

- Polycarpous and a Rhesus factor - conflict pregnancy

- Decompensation extragenital diseases

- Refusal of participation in a research.

The research is approved by the decision of ethical committee of the Omsk state medical university № 97 from 10.12.2017.

Methods of a research included all-clinical and laboratory data with determination of BMI, the waist circle (WC), level of arterial blood pressure systolic and diastolic. Levels of cholesterol, triglycerides, lipoproteid of the low density, high density, glucose of plasma of blood, creatinine, uric acid were defined by biochemical methods.

The statistical analysis was made with use of software packages of Microsoft Office 2007 and Statistica 10.0 (USA). The significance value is accepted as $p<0,05$. At a normal type of distribution of data defined average value with a standard deviation, for assessment of differences in groups applied methods of parametrical statistics (the dispersive analysis) to comparison of data in several groups. At abnormal distribution of data defined a median (Me) and an interqartile interval (25; 75). Applied methods of nonparametric statistics (Kraskela-Wallice's test) to assessment of differences in groups. For calculation of the statistical importance of qualitative distinctions the chi-square ($\chi 2$) (was applied at $p<0,05$ critical value $\chi 2=3,841459$). At creation of model of the birth of the large newborn the method of logical regression for the ROC-analysis was used.

Results

Complications in labor were observed at 689 (91,4%) patients. The most frequent complication was premature rupture of fetal covers (45,8% women with excess body weight, 44,2% women with obesity and 50% at women with normal body weight). Operation of Cesarean section was more often carried out at patients with obesity (43,5% against 32,8% and 32,3% respectively; $\chi 2=6,4$; $p=0,012$), what is confirmed with the correlation analysis ($G=0,16$, $p=0,0002$). At the same time the main indications for operation Caesarian section – the clinical discrepancy (in connection with a macrosomia) revealed at 38 women in labor with obesity (14,5%; $\chi 2=36,7$; $p=0,0002$) against 12 (4,6%; $\chi 2=10,9$; $p=0,0002$) at women with excess body weight. At women with normal body weight this pathology hasn't been revealed. The pre-natal hypoxia has been recorded at 40 (15,3%) at patients with obesity, 33 (12,6%) at women with excess body weight, against 39 (16,8) at women with normal body weight. On the basis of the obtained data it should be noted that women with obesity the frequency of a preeclampsia had higher than 3,5% against 1,1% at women with excess body weight and 0,43% with normal body weight respectively ($\chi 2 = 5,7$; $G=0,60$; $p=0,0002$).

The dispersive analysis of anthropometrical indicators of newborns has revealed statistically significant differences in the studied groups on weight ($H=88,4$, $p=0,00001$) and to growth ($H=73,1$, p

=0,00001), (Figure 1). The weight of children of women with obesity was 11,4% more in 1 group, than in the 2nd (p=0,00001) and 6,4% above in comparison with the 3rd (p=0,00001) (figure 1). Growth of children of women with obesity was 3,6% more, than in the 2nd group (p=0,000001), and for 1,9% - in comparison with the 3rd (p=0,000001).

In the analysis of a condition of children at the birth it is found out that among living newborns from mothers of 1 group full-term were 396 (87,4%), prematurely born – 43 (9,5%), perenoshenny – 14 (3,1%) children. Prematurity is caused in 9 (2%) cases by premature birth at patients of 1 group and 34 (7,5%) pregnant women of 1 group had Cesarean section by the prematurely born newborn in connection with preeclampsia. In group of comparison all newborns were born in time, distinctions are statistically significant $\chi 2=10,6$, $p<0,05$ (Figure 1).

Glucose level in blood of pregnant women fluctuated from 3,2 to 6,8 mmol/l (on average 4,55±0,63 mmol/l). Glucose level more than 4,7 mmol/l is revealed at 312 patients (41,4%). It isn't established differences in glucose level at women in groups (H=1,22, p =0,54) and his dependences on BMI (R=0,05, p =0,14), weight before pregnancy (R=0,054, p=0,29), the general increase of weight (R=0,012, p=0,75), weight before childbirth (R=0,045, p=0,22). The weight of children at women with gestational diabetes and without him statistically significantly didn't differ (p=0,86). Glucose level in blood at the women who have given birth to the large child corresponded to the level of women whose children had average anthropometrical parameters (Figure 2).

On the basis of the received results we have assumed that having data on BMI of the woman before pregnancy and the level of glucose in blood during pregnancy, it is possible to predict more precisely the birth of the large child and to define tactics of conducting childbirth.

The ROC analysis with creation of ROC curves and the analysis of the area under curve (AUC) has confirmed existence of a possibility of the forecast of the birth of the large child according to the BMI level before pregnancy and existence of increase in level of glucose in blood during pregnancy, however has been established that the most valuable

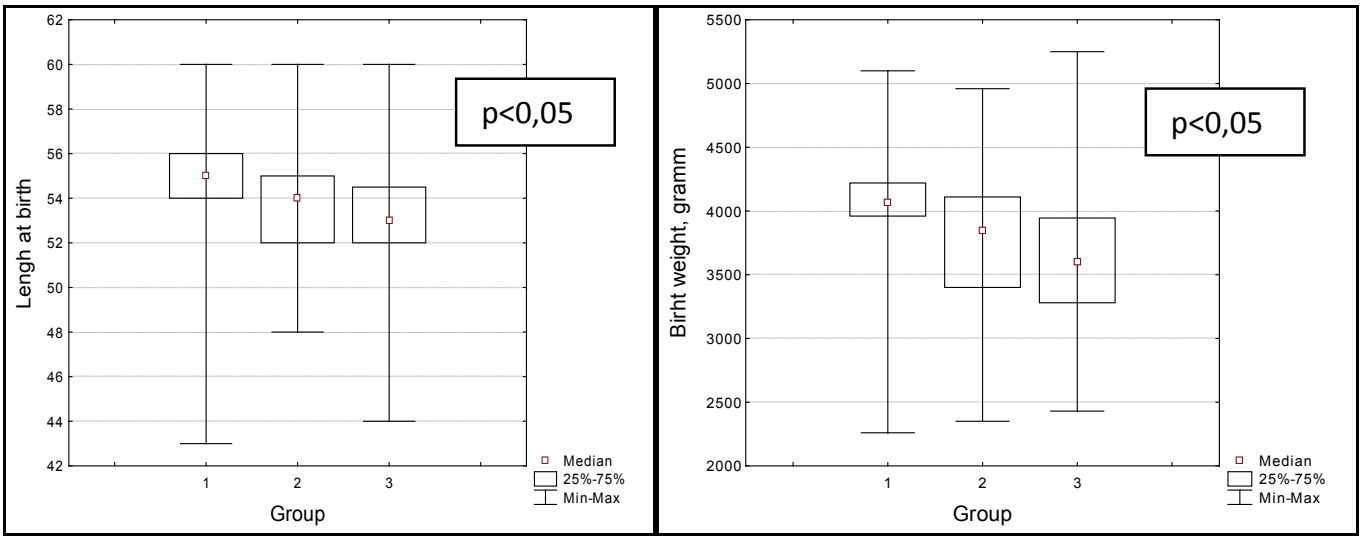

Figure 1: Anthropometrical parameters of newborn children.

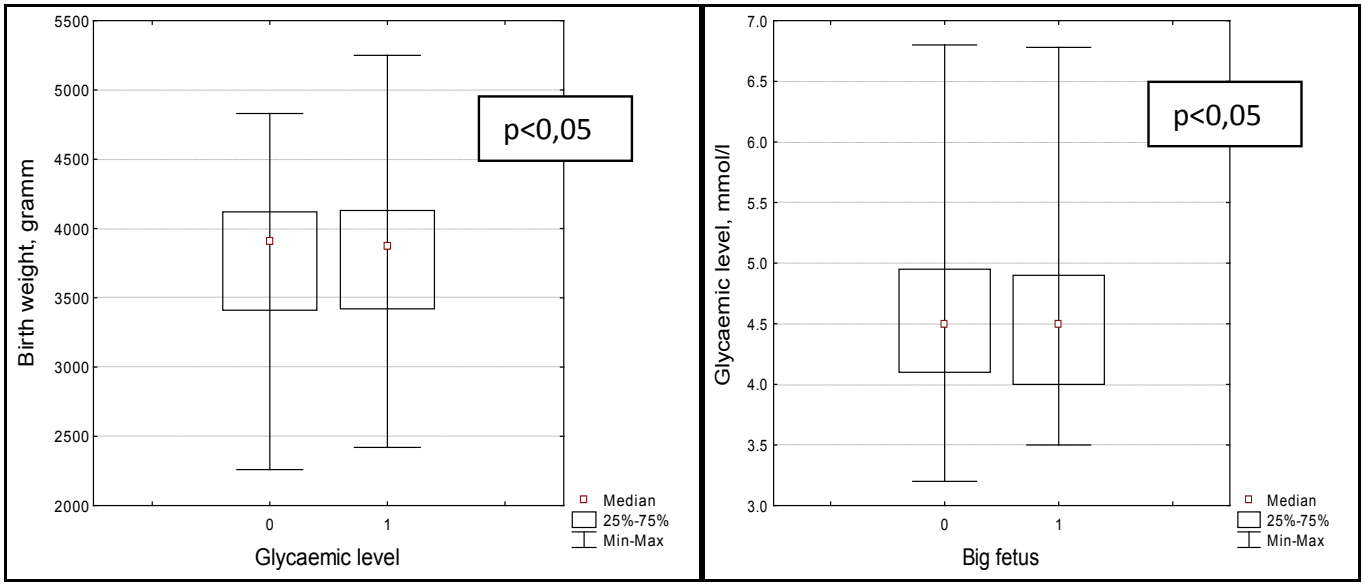

Figure 2: (A) The weight of the newborn child at women with normal (0) and the increased (1) level of glucose in blood during pregnancy; **(B)** glucose level in blood at the women who have given birth to large children (1) and children with average anthropometrical parameters (0).

predictor from these two parameters is BMI of the woman before pregnancy (Table 1 and Figure 3).

On the basis of data of the table it is possible to claim that at BMI more than 25 and glucose level in blood more than 4,5 mmol/l there is a high probability of the birth of the large newborn. At the same time the correlation analysis has shown direct positive link of average force of BMI and level of glucose. r=__, (Figure 4). In the Russian Federation determination of level of a glycemia is a screening method. According to us glucose of blood can be used as a macrosomia predictor for the purpose of allocation of women of risk group for profound inspection in the endocrinological centers.

Having divided outcomes on two possible (binary sign): the birth of a large newborn and the birth of a newborn with average anthropometrical parameters, for drawing up the forecast we have used binary logistic regression.

On the basis of results of logistic regression of continuous signs the predictive model of probability of the birth of a large newborn (table 2) has been constructed.

The probability (r) of the birth of the large child on the basis of this forecasting model is: $p=1/(1+e^{BMI*0,182-4,9})$, where e – the basis of a natural logarithm, the mathematical constant equal about 2,718.

Having added to model a glucose level indicator in blood, we have received the following results (Table 3).

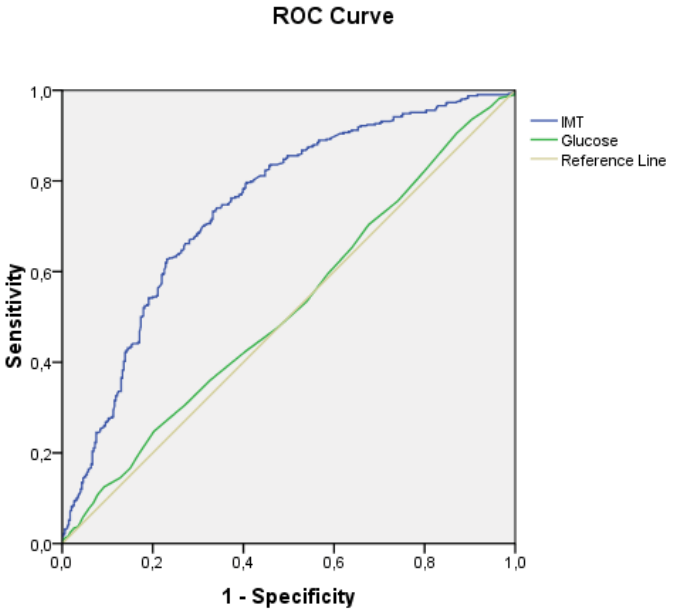

Figure 3: The ROC analysis constructed taking into account sensitivity and specificity of indicators of BMI of women before pregnancy and the level of glucose in blood during pregnancy.

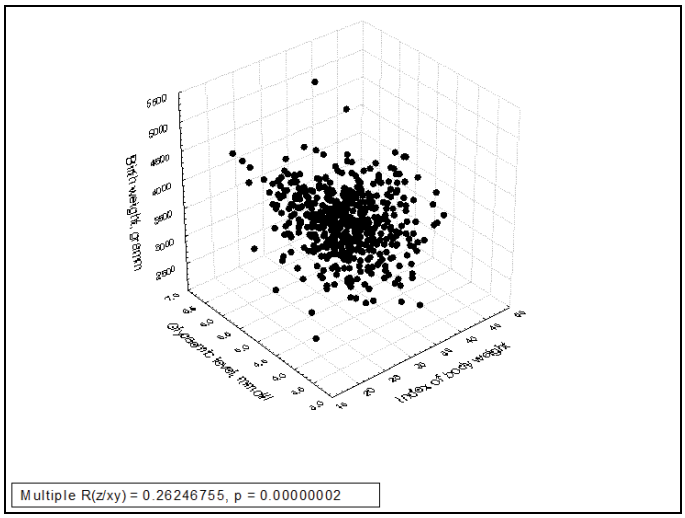

Figure 4: Interrelation of BMI before pregnancy, glucose level in blood during pregnancy and the weight of the newborn child.

Table 1: Results of the ROC-analysis for the revealed predictors of the birth of a large newborn.

Indicator	AUC (95% confidence interval)	p-level	optimalcut-offvalue	sensitivity (confidence interval), %	specificity (confidence interval), %
BMI before pregnancy	0,744 (0,708-0,780)	0,000	25	60,3 (57,8-62,9)	62,9 (60,5-65,4)
glucose level mmol/l	0,520 (0,479-0,561)	0,342	4,5	42,1 (30-55,2)	59,3 (46,2-72,5)

Table 2: A forecasting model of probability of the birth of the large newborn on the basis of an indicator of BMI of the woman before pregnancy.

Indicator	Analysis indicators			
	B (regression coefficient)	S.E. (standard error)	df	Sig. (significance)
BMI	0,182	0,018	1	0,000
Constant	-4,9	0,51	1	0,000
Chi-sq=129,2 df=1 p<0,0001				
Correctness of prediction: 70,2%				

Table 3: A forecasting model of probability of the birth of a large fruit on the basis of an indicator of BMI of the woman before pregnancy and the level of glucose in blood.

Indicator	Analysis indicators			
	B (regression coefficient)	S.E. (standard error)	df	Sig. (significance)
BMI	0,182	0,018	1	0,000
glucose level	0,076	0,127	1	0,55
Constant	-5,26	0,76	1	0,000
Chi-sq=129,6 df=2 p<0,0001				
Correctness of prediction: 70,3%				

Addition in model of one more parameter "Glucose Level in Blood" slightly increases the importance of model. The probability (r) of the birth of the large child on the basis of this forecasting model is: $p=1/(1+e^{BMI*0,182+0,076*glu-5,26})$.

Thus, the models presented in Tables 2 and 3 can with probability to 70,3% predict probability of the birth of the large child.

Discussion

A number of authors consider that glucose shouldn't be taken into account at discussion of risk of a macrosomia [16-18]. At the same time some researchers, in particular Li N. et al., Radulescu L. et al. in the works, don't exclude risk of development of a makosomiya in pregnant women with the high level of glucose of blood [18,19]. Therefore in the research when determining risk of formation of the large newborn we took two parameters (BMI and level of glucose) into account, considering that glycemia level in the Russian Federation is a screening method of inspection at pregnant women with obesity.

We believe that for more exact definition of predictors of a macrosomia it is necessary to use both parameters: level of glucose and calculation of BMI. In this case the model offered by us can be recognized adequate what has found reflection in works of Park S. et al., Scott-Pillai R. et al. [20,21]. Therefore we consider that the created predictive model can be used in broad clinical practice at screening inspection of pregnant women with obesity.

Conclusion

The excess body weight and obesity at mother promote formation of the large newborn. On the basis of results of logistic regression of continuous signs the predictive model of probability of the birth of a large fruit which can significantly predict probability of the birth of the large child (to 70,3%) is constructed and will allow to avoid perinatal complications.

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