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Fetal macrosomia: analysis of the maternal and neonatal outcomes and complications

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Abstract: *it is well known that the health of the child depends largely on the health of his mother during pregnancy. There are no clear criteria in the available sources and clinical protocols for predicting the risk of macrosomia, which may further adversely affect pregnancy management in general. Our aim was to analyze the maternal and neonatal outcomes and complications in Ukrainian cohort of patients during pregnancy with fetal macrosomia by conducting a prospective analysis of the history of pregnancies and childbirth of adolescent girls' mothers with gynecological pathology, born with large to gestational age from the reference indicators. This was a retrospective cohort study. 68 histories of pregnancy and childbirth were analyzed. The incidence of maternal and neonatal complications in pregnant women with macrosomia (birth weight greater than 4000 g) was compared with that in pregnancy with normal body weight (2500–4000 g). Macrosomia is associated with significantly higher maternal age and gestational age. In macrosomia, significantly more births were completed by caesarean section. With a fetal weight above 4500 g, the risk of postpartum hemorrhage increased. Macrosomia has been shown to be associated with severe adverse outcomes for both mother and fetus.*

Key words: fetal macrosomia, girls, puberty, menstrual cycle, pregnancy complications, cesarean section

Introduction

It is well known that the health of the child depends largely on the health of his mother during pregnancy. The crisis situation in the social, economic and other spheres of our life, environmental pollution have a direct negative impact on women of childbearing age (Tuchkina, I et al., 2021).

The health indicators of Ukrainian women are currently characterized by high maternal mortality, diseases of the reproductive organs, including sexually transmitted diseases, an increase in the frequency of infertility, menstrual disorders, and reproductive health disorders are noted already in childhood and adolescence.

Socio-economic reasons often force a woman to work in any conditions, including those that are harmful and hazardous to health, and this is associated with an additional risk of disruption of her reproductive functions, as well as the development of fetal and newborn pathology (Dinnik, V. O et al., 2020) .

Scientists are now defining fetal weight over 4,000 grams as a fetal macrosomia. It is associated with a significant risk of complications in the mother and newborn (Paige D. Wartko et al., 2021). Urgent caesarean section, postpartum hemorrhage or anal sphincter damage are often associated with macrosomal pregnancy(Li Shang

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et al, 2021). So there is a lot of information about neonatal complications, such as shoulder dystocia, clavicle or humerus fracture, and birth asphyxia (M.C. Vieira et al., 2019).

Aim

Our aim was to analyze the maternal and neonatal outcomes and complications in Ukrainian cohort of patients during pregnancy with fetal macrosomia by conducting a prospective analysis of the history of pregnancies and childbirth of adolescent girls' mothers with gynecological pathology, born with large to gestational age from the reference indicators.

Materials and Methods

The study was conducted at the clinical base of the Department of Obstetrics, Gynecology and Pediatric Gynecology of the Kharkiv National Medical University - "Kharkiv City Maternity Hospital No. 1". The study was approved by the Commission on Ethics and Bioethics of Kharkiv National Medical University and met the ethical standards of the Bioethics Committee, developed in accordance with the Helsinki Declaration of the World Association "Ethical Principles for Conducting Scientific Medical Research Involving Humans", as amended in 2013. All patients provided written informed consent to participate in the study.

We retrospectively analyzed 68 histories of pregnancies and childbirth of mothers of girls born with excess or deficiency of body weight. The patients were delivered from 2008 to 2013 in "Kharkiv City Maternity Hospital No. 1". The main group consisted of 26 mothers of adolescent girls with birth weight over 4000.0 g. The control group was formed by 32 mothers of girls born with a body weight of 3000 - 4000.0 gr.

Inclusion criteria: Accurate birth weight information, birth at gestational age 37-41 weeks. Patients born at less than 37 weeks or more than 41 weeks from multiple pregnancies were excluded from the study.

Statistical data processing was carried out using the Statistica 6.0 software package and Microsoft Excel Office 10. Hypotheses about the equality of the two means were tested using Student's t-test. The measurement was considered significant at $p<0.05$.In the absence of a normal distribution in the studied samples, nonparametric methods were used to compare groups. To compare two independent samples, the Wilcoxon-Mann-Whitney U test was used. The statistical significance of differences between qualitative characteristics was assessed using the $\chi 2$ test. The nature and severity of relationships between different indicators were determined using simple and rank correlation according to Spearman. Differences were considered statistically significant at $p<0.05$.

Results

A total of 68 participants were included in this study. Features of pregnancies, childbirth and perinatal outcomes are shown in Table 1.

Data are given as median (interquartile range) or n(%). Adjusted Bonferroni significance level, P=0.025. For comparison with normal-birth-weight (BW) group: *P<0.0001; P<0.01. CS, Cesarean section.

The main complication of pregnancy in the main group was preeclampsia of varying severity, the frequency of which was 38.2+3.6% and was significantly higher compared to other groups (21.4+3.0%, $p<0.001$).

Threatening abortion complicated the gestational process in the main group with approximately the same frequency, respectively, and was 17.4±3.9%, while in the 2nd group this pathology was 8.8±2.1% ($p< 0.05$).

Anemia was diagnosed significantly more often in mothers of girls significantly more often in the control group (19.2±2.9%, $p<0.01$) and 2.6 times higher than the corresponding figure in the main group (3.5±2.6%, $p<0.001$).

Of particular interest is the fact that in the main group the peak of the main complications occurred at the critical time for the gonads in the antenatal period of ontogenesis, namely at the gestational age of 17-20 weeks (12.9±2.5%, $p<0.05$), when in the dynamics of a strict sequence of follicular maturation in the ovaries of the fetuses, a period of primordial follicles is distinguished and at a gestational age of 25-30 weeks (18.0±2.9%; $p<0.001$), which corresponds to the period of precavitary follicles.

In women of the main group, there was another peak of complications, which occurred at 36-40 weeks of gestation (12.9±2.5%; $p<0.01$), coinciding with the appearance of large abdominal

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Table 1. Maternal and pregnancy characteristics in pregnancies delivering non-macrosomic fetus and those with fetal macrosomia

Maternal and pregnancy characteristics	Normal BW	Macrosomia
Age(years)	28.7 (24.2 – 32.5)	(25.5 – 34.6)*
Height(kg)	66.0 (58.0 – 78.0)	73.1 (63.9 – 90.0)*
Weight(cm)	1.64 (1.60 – 1.68)	1.67 (1.62 – 1.74)*
Chronic hypertension	0,86%	0,93%
Pre-existing diabetes mellitus	0,56%	0,61%
Gestational diabetes mellitus	2,45%	4,8%*
Nulliparous	52,3%	42,7%
Parous without previous macrosomia	42,6%	32,5%*
Parous with previous macrosomia	6,4%	24,6%*
Gestational age at delivery (weeks)	39,55(38,5 -40,6)	40,6(40,0 – 41,3)*
Spontaneous onset of labor	70,6%	58,9%
No labor, elective CS	10,45%	10,2%
Induction of labor	13,5%	33,5%*
Spontaneous vaginal delivery	69,8%	61,5%*
Instrumental vaginal delivery	10,1%	9,4%
Elective CS	11,5%	9,8%
Emergency CS	15,7%	22,4%*
Estimated blood loss (mL)	325(240-470)	430(320-700)

follicles. This may contribute to the disruption of the formation of structural and functional differentiation of the ovaries, and therefore, children born with a large body weight are at risk of developing reproductive dysfunction in the postnatal period of ontogenesis.

In the main group, there was a high incidence of such complications of childbirth as untimely rupture of amniotic fluid and anomalies in labor activity.

Untimely discharge of amniotic fluid in the main group(16.3±2.8%) was diagnosed almost 2 times more often than in the control group (9.3 +2.2%, $p<0.05$).

The same pattern was noted in relation to anomalies of labor activity, which in the main groups (16.9+2.8%) is almost 2 times higher than the frequency of this complication in control group (9.9±2.2%, $p<0.05$).

The average birth weight in the control group was 3243.6±27.1 grams, and in the main group it was 4277.8±73.5 grams, height was 52.0±1.3 cm, 54.7±1.0 cm, respectively. .

Birth trauma of newborns occurred in the main group in 9.6+2.2%, which is more than 2 times higher than the same indicator (3.8+1.4%, $p<0.05$) in the control group.

Discussion

The obstetrician-gynecologist always needs to choose the proper management of pregnancy and childbirth with suspected macrosomia (Julius Nuwagaba et al., 2022). Our work shows that with an increase in birth weight, there is a risk of caesarean section and postpartum hemorrhage, as

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well as neonatal complications such as shoulder dystocia and neonatal hypoglycemia.

The age of pregnant women with macrosomia was significantly higher in the control group. We have shown that the risk of macrosomia increased at gestation greater than 40 weeks. With the risk of developing macrosomia, the frequency of caesarean section increases.

Recently scientists proved that ultrasound assessment of fetal macrosomia increases the risk of caesarean section, regardless of the actual weight of the fetus at birth (Committee on Practice Bulletins, 2020).

The frequency of pregnancy, which was accompanied by gestational and pregestational diabetopathy was 4.3% in our study, which coincided with the data of previous studies (Fayed A et al., 2022). Diabetes mellitus significantly more often accompanied macrosomal pregnancies. We found a higher incidence of perineal soft tissue ruptures in macrosomia. The fact of increased risk of postpartum hemorrhage has long been generally recognized, and our data coincided with those already known (B.J. Voskamp et al., 2020). The risk of shoulder dystocia increased with increasing gestational age at delivery and in diabetic pregnancies (Mark A. Clapp et al., 2022).

Conclusion

Thus, the overall frequency of complications during pregnancy was higher in mothers of girls born large to gestational age, with their occurrence at a critical time for the gonads, which contributes to the disruption of the processes of structural and functional differentiation of the gonads in female fetuses. In the 1st group, pregnancy was significantly more often complicated by preeclampsia, the frequency of which was 38.2+3.6%, $p<0.001$.

Among the complications of labor in the main group, untimely rupture of amniotic fluid and anomalies in labor activity dominated. The frequency of birth injuries of large newborns, noted by pediatricians, was 2 times higher compared to children born with an average body weight, which will negatively affect the formation of the central mechanisms of regulation of reproductive function in them. Untimely discharge of amniotic fluid in the main group(16.3±2.8%, $p<0.05$). The same pattern was noted in relation to anomalies of labor activity, which in the main groups 16.9+2.8%, $p<0.05$.

Our work shows that pregnancy and childbirth with macrosomia are associated with numerous serious complications, leading to adverse outcomes for both the mother and the infant. Of particular interest is the fact that in the main group the peak of the main complications occurred at the critical time for the gonads in the antenatal period of ontogenesis, namely at the gestational age of 17-20 weeks (12.9±2.5%, $p<0.05$), when in the dynamics of a strict sequence of follicular maturation in the ovaries of the fetuses, a period of primordial follicles is distinguished and at a gestational age of 25-30 weeks (18.0±2.9%; $p<0.001$), which corresponds to the period of precavitary follicles.

In women of the main group, there was another peak of complications, which occurred at 36-40 weeks of gestation (12.9±2.5%; $p<0.01$), coinciding with the appearance of large abdominal follicles. This may contribute to the disruption of the formation of structural and functional differentiation of the ovaries, and therefore, children born with a large body weight are at risk of developing reproductive dysfunction in the postnatal period of ontogenesis.

The identification of prognostic criteria for the development of macrosomia is necessary to assess the risks of pregnancy and childbirth.

Birth trauma of newborns occurred in the main group in 9.6+2.2%, $p<0.05$.

Financing

This study hadn’t obtained external funding.

Conflicts of interest

Authors have no conflict of interest to declare.

Consent to publication

All authors have read and approved the final version of the manuscript. Authors have agreed to publish this manuscript.

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of article

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Макросомія плода: аналіз материнських та неонатальних результатів та ускладнень

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Анотація загальновідомо, що здоров›я дитини багато в чому залежить від здоров›я матері під час вагітності. У доступних джерелах і клінічних протоколах відсутні чіткі критерії прогнозування ризику макросомії, що може негативно позначитися на веденні вагітності в цілому. Нашою метою було проаналізувати материнські та неонатальні результати та ускладнення в українській когорті пацієнтів під час вагітності з макросомією плода шляхом проведення проспективного аналізу анамнезу вагітностей та пологів матерів дівчат-підлітків із гінекологічною патологією, народжених від великого до гестаційного віку від опорні показники. Це було ретроспективне когортне дослідження. Проаналізовано 68 історій вагітності та пологів. Частота материнських та неонатальних ускладнень у вагітних з макросомією (маса тіла при народженні понад 4000 г) порівнювалася з такою при вагітності з нормальною масою тіла (2500–4000 г). Макросомія пов›язана зі значно вищим віком матері та гестаційним віком. При макросомії достовірно більше пологів завершилося кесаревим розтином. При масі плода понад 4500 г збільшувався ризик післяпологової кровотечі. Було показано, що макросомія пов›язана з важкими несприятливими результатами як матері, так плода.

Ключові слова: макросомія плода, дівчатка, статеве дозрівання, менструальний цикл, ускладнення вагітності, кесарів розтин.