

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 1223 (26.01.2017).  
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 05.09.2017. Revised 10.09.2017. Accepted: 10.09.2017.

# Wpływ cukrzycy ciężarnej na rozwijające się dziecko

## The influence of gestational diabetes mellitus on the developing baby

Natalia Świątoniowska<sup>1</sup>, Anna Rozensztrauch<sup>2</sup>

<sup>1</sup>Studenckie Koło Naukowe Pielęgniarstwa Pediatricznego, Wydział Nauk o Zdrowiu, Uniwersytet Medyczny Wrocław

<sup>2</sup>Katedra Pediatrii, Wydział Nauk o Zdrowiu Uniwersytetu Medycznego im. Piastów Śląskich we Wrocławiu

<sup>1</sup>Pediatric Nursing Student Association, Faculty of Health Science, Wrocław Medical University

<sup>2</sup>Department of Pediatric, Faculty of Health Science, Wrocław Medical University

<sup>1</sup>lic. Natalia Świątoniowska <sup>2</sup>dr n. o zdr. Anna Rozensztrauch

### Contact address:

dr n. o zdr. Anna Rozensztrauch

ul. K. Bartla 5, 51-618 Wrocław

phone: 503 585 939

e-mail: [anna.rozensztrauch@umed.wroc.pl](mailto:anna.rozensztrauch@umed.wroc.pl)

### Streszczenie

Cukrzyca ciążowa dotyczy około 10% kobiet w Polsce. Skutki nieleczonej cukrzycy ciężarnych widoczne są już w okresie prenatalnym. Opieka nad dzieckiem matki chorej na cukrzycę ciążową powinna rozpocząć się w chwili rozpoznania GDM. Przestrzeganie zaleceń terapeutycznych przez ciężarne kobiety z cukrzycą ciążową daje szanse na urodzenie zdrowego dziecka oraz ma wpływ na przebieg ciąży, porodu oraz dalszy rozwój dziecka.

### Summary

Gestational diabetes mellitus involves about 10% of women in Poland. The consequences of untreated gestational diabetes mellitus are seen in the prenatal development. The nursing care for the diabetes mother's newborns should be started in the moment of diagnosing. The treatment adherence of pregnant diabetic women gives a chances for having healthy baby and has an influence on the pregnancy, deliver and further baby growth.

**Słowa kluczowe:** cukrzyca ciążowa, noworodek, opieka  
**Key words:** gestational diabetes mellitus, newborn, nursing care

### Introduction

Gestational diabetes mellitus is the most common complication occurring during pregnancy. It is estimated that this problem affects approximately 10% of women in Poland [1]. During this period, it is important to the proper conduct of pregnancy by monitoring the health of pregnant mothers and baby. A baby with diabetes is at risk of the occurrence of a number of complications that may arise at the stage of organogenesis. A prerequisite for its proper development is to maintain correct glucose level during pregnancy, because the developing baby is very sensitive to fluctuations in blood glucose levels.

Childcare do not end up with the delivery. During the labour can occur injuries caused by fetal macrosomia, and just after the birth are often neurological, respiratory, circulatory and metabolic disorders. Furthermore, there are distant effects of diabetes in pregnancy. These children were significantly more likely to develop metabolic syndrome compared to children with uncomplicated pregnancies.

### Gestational diabetes

Gestation diabetes mellitus (GDM) is defined as any degree of glucose intolerance and have been identified during pregnancy.

The risk factors for hyperglycemia in pregnancy are age above 35 years, polycystic ovary syndrome, birth of a child with a high birth weight, with a malformation, previous miscarriage, hypertension, obesity, gestational diabetes in a previous pregnancy, a family history of type 2 diabetes and parity [2].

The time of the test	The glucose concentration in venous plasma	
On an empty stomach	92-125 mg / dl	5,1-6,9 mmol / l
In the 60th minute	≥ 180 mg / dl	≥ 10.0 mmol / l
In the 120th minute	153-199 mg / dl	8.5-11.0 mmol / l

Table 1. Criteria for GDM diagnosis after administration 75 g of glucose OGTT IADPSG by WHO in 2010 and 2013

Source: Recommendations regarding clinical management of patients with diabetes in 2017 (available at URL: [https://cukrzyca.info.pl/zalecenia\\_kliniczne/zalecenia\\_kliniczne\\_dotyczace\\_postepowania\\_u\\_chorych\\_na\\_cukrzyce\\_2017](https://cukrzyca.info.pl/zalecenia_kliniczne/zalecenia_kliniczne_dotyczace_postepowania_u_chorych_na_cukrzyce_2017))

### The impact of gestational diabetes on the child

Pregnant women with diabetes is associated with a high risk of fetal abnormalities - diabetic fetopathy and embryopathy. The reason for this is the lack of maternal glycemic control and abnormal regulation of homeostasis. The clinical condition of the newborn diabetic mother (NDM) is dependent on many factors, first of all classes of diabetes, diabetes control and complications other than diabetes.

Effects of diabetes pregnant visible from the prenatal period until adolescence. Newborn mothers with diabetes is exposed to the occurrence of a number of disorders, the presence and degree dependent diabetes control. Both high and low glucose levels have an impact on the fetus from the beginning of pregnancy [3,4].

### Intrauterine deaths

The first effects of the GDM can be seen in disorders of organogenesis. Especially in the first trimester are often stillbirth. Their cause is a misalignment advanced diabetes and vascular

changes. Fetal death may occur at any stage of gestation [5]. Mortem examinations of newborns more often than mothers of healthy children showed cardiac dysfunction - cardiomegaly and cardiomyopathies [6].

### **Birth defects**

There are a result of disorders of organogenesis, apply 3-5 times more often in the NMC than babies born to mothers without diabetes. Typically involve the heart (30%), the skeleton (20%), central nervous system, and the genitourinary system [7].

Heart defects include aortic stenosis, above all, single-chamber heart, transposition of the great vessels. Approximately 50% of the NDM between 21 to 32 weeks are diagnosed with hypertrophic cardiomyopathy, and 10% is detected cardiomyopathy with evidence of heart failure. The cause of cardiomyopathy is considered to deposit on cardiac tissues glycogen, which is the result of fetal hyperinsulinemia, as well as the factors within the mother [8]. Cardiomyopathy in NDM, in most cases resolve spontaneously without treatment over several months [8,9]. On the other hand, anomalies in the CNS are mainly anencephaly, acrania, spina bifida and a team of cross-regression. The team cross-regression is particularly common in the NDM (about 200-400 times more likely).

Treatment of cardiomyopathy depends on the severity of symptoms. It is based on the administration of diuretics and / or beta-blockers. In the most severe cases, it is necessary to apply the extracorporeal blood oxygenation [9, 10].

Diagnosis of defects in a child is based primarily on the results of ultrasound during pregnancy. This gives the possibility of early to prepare pregnant, and to prepare conditions for the birth. Syndrome intervention, depending on the type of defect may comprise a surgeon, cardiac surgery, neurosurgical or resuscitation assembly. Prevention of congenital defects includes obtaining correct glucose level before pregnancy [11].

### **Metabolic disorders**

In the first hours after delivery, the NDM may experience metabolic disorders hypoglycaemia (25-50%), hypocalcemia (10-50%), and hypomagnesaemia (30-75%). Electrolyte imbalance caused by transient hypoparathyroidism and parathyroid hormone deficiency as a result of the decrease in the magnesium concentration in maternal blood. Newborns with metabolic disorders are sleepy, apathetic and restless, there may be convulsions, tremor of the extremities, cyanosis, and sleep onset of heart failure and cardiac arrest [12].

Hypocalcemia in the newborn is diagnosed when the level of calcium is lower than 1.75 mmol / l. Usually resolves spontaneously. Sometimes requires intravenous administration of 10% calcium gluconate solution of 5% glucose under the control of the ECG.

Hypomagnesaemia (magnesium concentration below 0.6 mmol / l) in the NDM occurs as a consequence of a disturbed magnesium ion transport across the placenta. Alignment of magnesium deficiency comprising the administration of 50% of magnesium sulfate at a dose of 0.1-0.3 mc mg/kg.

The most common ion disorders worsen 2-3 times of the child's life. Diagnosis electrolyte imbalance is based on determining the concentration of calcium, magnesium and acid-base balance in cord blood collected prior to the first breath of the child [13].

As many as 65% of the NDM may also have iron deficiency. This is due to improper distribution of iron in the body. It is assumed that its deficiency can have an impact on the incidence of neurological disorders in newborns of mothers with diabetes [14].

### **Hypotrophy**

Intrauterine fetal hypotrophy, which are below the 10th percentile, occur in 20% of cases. It applies to babies born to mothers who long have diabetes and who have been diagnosed with

such complications - nephropathy and retinopathy. In women, these vascular changes occur in the placenta, resulting in the impairment of fetal nutrition [7]. These newborns are at high risk of perinatal shock, acute hypoxia, metabolic disorders and polycythaemia. Both fetal hypertrophy and hypotrophy exhibit characteristics of prematurity, and thus require special care [12,15,16].

### **Macrosomia, perinatal injuries and hypertrophy**

Macrosomia, which is located above the 90th percentile occur in about 15-45% pregnancies of mothers with diabetes. In contrast to IUGR, macrosomia is observed in fetuses of women who suffer from long ago and also had a significant overweight or above 4000 g birth. Macrosomia is caused by persistent hyperglycemia, which causes fetal increase in insulin secretion. Hyperglycemia and hyperinsulinemia stimulate lipogenesis and fat growth. This process relates to organ whose metabolism is dependent on insulin: liver, spleen, heart, muscle and adipose tissue [12,17,18]. Hypertrophy of the fetus often leads to termination of pregnancy by caesarean section and perinatal injury. The newborn is exposed to, among others, shoulder dystocia, facial palsy, the occurrence of subperiosteal hematoma. Also demonstrated a relationship between increased birthweight and the risk of fetal asphyxia and meconium aspiration syndrome. [5,19,20].

### **Breathing disorders**

10-30% of infants of diabetic mothers are premature. Baby born prematurely is exposed to a lot of complications, including hypoxia and respiratory distress syndrome. At NDM 4-6 times more likely to occur may IRDS (ang. Infant Respiratory Distress Syndrome). The infant respiratory distress syndrome consists of a deficiency of endogenous surfactant, lung immaturity and disorders of the pulmonary circulation. Prevention of IRDS is the alignment of diabetes and metabolic stimulants administration of lung development. The treatment is used for oxygen therapy and the administration of exogenous surfactant into the endotracheal tube [12,21].

Delay of fluid uptake of pulmonary alveoli and airways can cause temporary breathing disorders (TTN, ang. Transient tachypnea of the newborn). It is respiratory problem that can be characterized in the newborn shortly after delivery. Usually, resolves spontaneously within 1-2 days after birth. In the treatment of TTN oxygen therapy is used directly in the incubator method, the n-CPAP or Infant-flow [12.9].

### **Haematological disorders**

Polycythemia identified by a value of hematocrit (65%) is a disorder resulting from chronic fetal distress [9]. Occurs in approximately 20-40% of the NDM [10]. Polycythemia leads to an increased blood viscosity, resulting in a thrombotic lesions (especially renal vein) and necrotizing enterocolitis. Polycythemia symptoms are not specific and can mimic the symptoms of hypoglycaemia. Hypoxia caused by thrombosis is manifested in the newborn by tachycardia, tachypnea, and RDS. Untreated polycythemia can produce symptoms of CNS: apnea, seizures, decreased reflexes, coma, and congestive heart failure [9,10,22].

Newborns immediately after the birth requires careful observation and to carry out certain tests to detect possible anomalies. In the first day of the newborn's life acid-base balance test should be performed. In the second day: electrolytes, morphology, markers of infection, the level of bilirubin, echocardiography, cranial and abdominal ultrasound, Polycythemia treatment is based on intravenous administration of 0.9% NaCl or 5% solution of albumin and / or partial exchange transfusion [4,7].

### **Asymptomatic hypoglycemia**

It is a common complication of diabetes mother. According to various sources, up to 90% applies to the NDM. It recognized, if the sugar concentration is kept below 40 mg / dl. It occurs due to lack of supply of glucose by the placenta and persistent hyperinsulinemia with NDM. Hypoglycaemia reaches its peak between 1 and 3 hours of life and requires the administration of glucose for the first two days. Hyperglycemia of blood cord may be one of the precursor of hypoglycaemia. Sometimes occur in the newborn as a tremor, decrease of muscle tone, anxiety disorders, thermoregulation, skin pallor, cry, tachypnea or apnea, cardiac failure or arrest [9,23].

Newborns with hypoglycemia requires constant observation. The measurement of glucose should be run initially every half hour for the first 2 hours, then every 2-3 hours until the end of 2 days of life. The recommended level of glucose should be maintained in the range of 60-150 mg / dl. Recommended testing in this period: the level of insulin, ketones, cortisol, and lactate.

If the blood sugar is at or above 40 mg / dl it is enough to start feeding or be orally administered with 10% glucose solution at 8 mg / kg min for. In the case of blood glucose concentration below 30 mg / dl roll the 10% glucose solution for 2-3 minutes, and further 6-8 mg glucose per kg min for should be administered. In difficult cases, glucagon roll (30 ug / kg., the maximum dose 1 mg) may be given. The use of high glucose concentrations indicates hyperinsulinism and is an indication for the supply of diazoxide, somatostatin, or hydrocortisone [23,24].

### **Hyperbilirubinaemia**

It is diagnosed when the level of bilirubin in the first day of life to exceed 5 mg / dl bilirubin when the level rises at a rate greater than 5 mg / dL per day or 0.3 mg / dl within one hour. It occur in approx. 25-30% of the NDM. These newborns are at risk of severe jaundice [25,26]. The main causes of jaundice is polycythemia, enzymatic immaturity of the liver, severe hemolysis, intrauterine hypoxia and infection. Hyperbilirubinemia can lead to kernicterus and acute bilirubin encephalopathy [9,27]. Therapy is adjusted for age, body weight, and neonatal risk factors. Phototherapy is used for the treatment [28,29].

### **Infections**

The proportion of infections in infants born to mothers with diabetes varies between 7 and 25% and is higher than in healthy newborns of women. Infections are a major cause of perinatal mortality due to immature immunological system [9,30]. In addition, the causes can be the coexistence of congenital defects or metabolic diseases. Also intravenous cannulation, many procedures and long maintenance of cardiopulmonary resuscitation increase risk of infection [9]. Risk factors dependent on if the mother had infection during pregnancy (in particular the presence of infection in the birth canal, or urogenital system), and diagnostic and therapeutic procedures, premature rupture of fetal maternal fever during the perinatal period and preterm delivery. The most common infection is an intravenous site infection and pneumonia [31,32,33]. Urinary tract infections, meningitis and osteoarthritis are also observed [9,10].

The diagnosis of infection is difficult because of the large variability of nonspecific symptoms. Every suspect case should be subjected to laboratory tests and microbiological. Neonatal distinct markers of infection are increased C-reactive protein levels, leukopenia, serum calcitonin and thrombocytopenia [31,33].

## **Neurological disorders**

The most severe neurological disorders are periventricular/intraventricular hemorrhage (PVH/IVH). They are mainly the result of perinatal hypoxia and the immaturity of central nervous system (CNS) and other organs [34]. Bleeding may have different effects. The size and severity of hemorrhage is graded from 1 (mild) to 4 (severe). Bleeding of the first and second stage rarely produce significant symptoms, while the degree of bleeding of the third and fourth are characterized by the newborn decreased muscle tone, convulsions, apathy. They can lead to shock and even death. Developmental disorders, hearing and vision impairment, epilepsy may result [9,13].

The diagnosis of bleeding is based on the basis of symptoms and imaging tests: ultrasound, CT, MRI. The study also allows assessment of diagnosis of bleeding and hydrocephalus, which must be decompressed via lumbar puncture under ultrasound guidance [34,35].

NDM, in which there were no serious disturbances of the nervous system, often characterized by an abnormal pattern of sucking and swallowing lack of coordination. If the glycosylated hemoglobin levels of less than 6%, brain NMC does not differ from the brain of healthy newborn the mother given its maturity [36].

## **Childcare**

Childcare of mother suffering from gestational diabetes begins at diagnosis of GDM. Adherence to treatment recommendations for pregnant women with gestational diabetes will give you chances of having a healthy baby and affect the course of pregnancy, childbirth and the further development of the child.

According to recommendations of PDA (ang. Polish Diabetic Association) for 2017, blood glucose level in pregnant fasting should be in the range of 70-90 mg / dl (3,9-5,0 mmol / l). While the value of glucose 1 hour after the food intake should not exceed 140 mg / dl (<7.8 mmol / l). The method of glycemic control depends on the value of fasting, and 1 and 2 hours after a meal. The GDM is preferable to multiple daily insulin injections. The demand for insulin in the mother after birth decreases and it is possible to complete withdrawal. Oral antidiabetic agents are not recommended for lack of sufficient information about the remote consequences for the fetus [2].

Pregnant mothers with GDM pregnancy is high risk, and therefore requires a comprehensive child care. The size of the fetus depends on the method of termination of pregnancy. Fetal weight exceeding 4000-4250g is an indication for cesarean section. Sometimes in order to avoid the risks posed by Caesarean section birth is induced at 38 weeks of pregnancy, when the fetal weight less than 3600g. From 36 weeks of pregnancy the number of visits increases. During this period it is recommended to perform tests to biophysical fetus [37,18].

Childbirth pregnancy complicated by diabetes should be done in centers with a high specialized hospital. In the delivery room should be a neonatologist, who will examine a child for possible anomalies. The newborn must be observed in the intensive care unit. Among the tasks the team is monitoring vital signs, and observation of the child for signs and symptoms indicative of metabolic disorders, hematological, neurological or cardio-respiratory. Therapeutic depends on the child's condition and the detected anomalies. The collected data should be properly documented and interpreted. The child should have established peripheral injection in a manner consistent with the principles of aseptic procedure. This is especially important because of the risk of infection. Personnel should encourage the mother breast feeding where there are no contraindications [2]. Breastfeeding reduces the risk of obesity and type 2 diabetes in the child. The best results, feeding for at least one year [38]. Because of the risk of asymptomatic hypoglycaemia, immediately after birth we must determine the

concentration of glucose in the blood, in the case of hypoglycemia start breast-feeding. If, despite the feeding the glucose concentration is not increased or maintained hypoglycaemia the intravenous glucose under the control of blood glucose should be given [39].

A newborn baby can be discharged home after 7 days of life. In order to eliminate the risk of child developmental disorders requires observation in the Outpatient Assessment Development under 3 years of age. In addition, we should evaluate its somatic and neurological development. In the first year of life a child should be made an oral glucose tolerance test to assess the risk of diabetes. NMC parents should be prepared to care for a child. The doctor and nurse should educate parents about the child care, ways of coping with difficulties and the situations in which they should contact the medical staff [39].

### **Distant consequences of diabetes occurring during pregnancy**

The occurrence of gestational diabetes is not without effect for a further period of child development up to adolescence. Child has a tendency to obesity, insulin resistance, and impaired glucose tolerance [40]. Great importance to the health of the child is early detection of possible abnormalities in the baby using simple screening tests. Nurse education environment in cooperation with the PHC physician should pay attention to the possibility of irregularities in the child. To do this, parents should be informed about the need of the control of the child's BMI, as well as the need for measuring blood pressure oral carbohydrate tolerance. A family doctor in case of irregularities should direct the child to specialists.

### **Summary**

The incidence of diabetes is now one of the most important medical problems. It should be stressed that diabetes also occurs in young women of childbearing age. Metabolic disorders in pregnancy affect both the mother and the child. The effects of diabetes in pregnancy in a child can be seen from the prenatal period until they reach adulthood. In order to prevent complications of gestational diabetes, every woman should have made an oral glucose tolerance test during pregnancy. Women at risk should carry out a test before the planned pregnancy. In addition, experts recommend folic acid 0,4 mg per day of a planned pregnancy to protect the child from malformations. During pregnancy, it is important to achieve correct glucose level by the methods of both pharmacological (insulin) and non-pharmacological (diet and physical activity). Further activities include monitoring the health of mother and child until the postpartum period and the prompt detection of irregularities and responding to possible complications. Because gestational diabetes carries with it the risk of a number of diseases, should emphasize the role of nurses and GP in quickly detect anomalies.

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