Gestational diabetes mellitus: the effects of diagnosis time and implementation of diabetic care on management of glycemia

Wpływ czasu rozpoznania cukrzycy ciążowej i wdrożenia programu opieki diabetologicznej u kobiet w ciąży na wyrównanie glikemii

Andrzej Gruszka[1], Olga Adamczyk-Gruszka[2], Izabela Lewandowska-Andruszuk[3], Marzena Siennicka[4], Jakub Gruszka[5]

[1]Practice, Kielce, Poland
[2]Department of Obstetrics, Gynecology and Obstetric-Gynecological Nursing, Faculty of Health Sciences, Jan Kochanowski University, Kielce, Poland
Head of Department: Prof. Mariusz Bidziński MD, PhD
[3]Department of Gynecological and Obstetric Prophylaxis, Faculty of Health Sciences, Jan Kochanowski University, Kielce, Poland
Head od Department: Prof. Wojciech Rokita MD, PhD
[4]Ewa Piotrowska Princess Anna Mazowiecka University Hospital, Warsaw, Poland
[5]II Faculty of Medicine, Medical University of Warsaw, Poland
Head of Department: Prof. Marek Kuch MD, PhD

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Słowa kluczowe: ciąża, cukrzyca u kobiet w ciąży, nietolerancja glukozy w ciąży.

Abstract

Introduction: Pregnancy is considered diabetogenic condition related to increased requirements for insulin, its increased secretion and ongoing insulin resistance. In pregnancy increased insulin secretion cannot compensate increased requirements which leads to gestational diabetes mellitus (GDM). If diagnosed too late or ill-treated diabetes can cause serious complications in the course of pregnancy and delivery as well as late complications in neonate.
Aim of the research: To assess if time of diagnosis of gestational diabetes mellitus and implementation of diabetic care influence glycemia management and clinical condition of neonate after birth.
Material and methods: The survey was carried out in the group of 300 pregnant women with GDM. The patients were divided into 3 groups: group A – patients with GDM diagnosed between 10–12 week hbd, group B – patients who had GDM diagnosed between 24–28 week hbd and group C – GDM diagnosed between 29 week hbd and delivery.
Results: The analysis revealed correlation between the frequency of GDM and patient's age and body mass index. Time of GDM diagnosis and following recommendations for GDM management depend on patient's place of living and socio-economic status. Neonate's condition is affected by proper glycemia management.
Conclusions: There is a correlation between place of living, poor socio-economic status and managing glycemia, which should contribute to developing effective methods of care for women living in those areas. Patients' body mass index significantly correlated with fetus macrosomy, which significantly affected the way pregnancy was terminated and neonate's condition after birth. Time of GDM diagnosis has a big influence on glycemia management which is essential for mother's and neonate's health.

Streszczenie

Wprowadzenie: Ciąża uznawana jest za stan diabetogenny związany ze wzrostem zapotrzebowania na insulinę, zwiększonym jej wydzielaniem i narastającą insulinoopornością. W ciąży wzrost wydzielania insuliny nie jest w stanie skompensować wzrostu zapotrzebowania, co powoduje rozwój cukrzycy ciążowej. Cukrzyca późno rozpoznana lub nieprawidłowo leczona wiąże się ze zwiększonym ryzykiem występowania powikłań w przebiegu ciąży i porodu, a także późnych powikłań u dziecka.
Cel pracy: Ocena, czy czas rozpoznania cukrzycy ciążowej i wdrożenia programu opieki diabetologicznej u kobiet z cukrzycą wpływają na wyrównanie stężeń glikemii oraz stan kliniczny noworodka po porodzie.
Materiał i metody: Do badania zakwalifikowano 300 pacjentek w ciąży z rozpoznaną cukrzycą ciążową. Pacjentki podzielono na 3 grupy: grupa A – pacjentki z rozpoznaną cukrzycą między 10. a 12. tygodniem ciąży, grupa B – pacjentki, u których rozpoznano cukrzycę między 24. a 28. tygodniem ciąży, i grupa C – pacjentki z rozpoznaną cukrzycą od 29. tygodnia do rozwiązania.

Wyniki: Stwierdzono zależność występowania cukrzycy od wieku pacjentek oraz wskaźnika masy ich ciała. Czas rozpoznania oraz przestrzeganie zaleceń dotyczących prowadzenia cukrzycy zależy od miejsca zamieszkania oraz statusu socjoekonomicznego kobiet. Wpływ na stan kliniczny noworodka po porodzie ma wyrównanie wartości glikemii.
Wnioski: Istnieje związek pomiędzy miejscem zamieszkania, złym statusem socjoekonomicznym a wyrównaniem glikemii, co powinno się przyczynić do opracowania metod skutecznej opieki nad kobietami z tych grup. Stwierdzono występowanie istotnej korelacji między wartościami wskaźnika masy ciała u pacjentek a makrosomią płodu, która istotnie wpływa na sposób ukończenia ciąży i stan noworodka po porodzie. Czas rozpoznania cukrzycy ciążowej wpływa na wyrównanie glikemii, co ma istotne znaczenie dla stanu zdrowia matki i noworodka.

Introduction

Diabetes is considered a disease of civilization. It is perceived in individual and social aspects as it is affecting more and more people and the number of individuals who suffer from diabetes is growing fast. It is a metabolic impairment which often goes undiagnosed until pregnancy. It causes serious concern as it affects health of both pregnant woman, developing fetus and neonate [1, 2].

Pregnancy does not cause diabetes but it can expose pathogenic mechanisms of primary diabetes, such as onset of type 2 diabetes, existing but undiagnosed type 2 diabetes, slow onset of type 1 diabetes, new case of type 1 diabetes producing typical symptoms [3].

Gestational diabetes mellitus (GDM) is a separate type of carbohydrate disorder, often defined as various degree of glucose intolerance which either first appeared or was first diagnosed in pregnancy. The GDM affects 2–8% pregnant women [2]. Literature quotes diverse data. i.e. 0.7% to 12.3% [4].

In pregnancy pre – and post-receptor insulin resistance develops as a result of hormonal changes that occur in pregnant woman, increased hormonal concentration or insulin antagonistic hormones (growth hormone, progesterone, placental lactogen). Risk factors of GDM include: age of pregnant woman > 35 years, overweight prior to pregnancy, GDM diagnosed in previous pregnancies, multiparas, history of giving birth to neonates weighing > 4,000 g, birth defects, intrauterine fetal deaths, family history of type 2 diabetes, hypertension, environmental factors and lifestyle, eating habits, and level of medical care [5–8].

To achieve good obstetric parameters it is important to diagnose GDM as early as possible and implement prompt measures to prevent obstetric complications. Those include managing metabolic disorders by adequate diet, insulin therapy, and moderate physical activity [9]. If mother's glycemia is normalized, the frequency of macrosomy of the fetus, Caesarean sections undertaken to terminate pregnancy or complications for neonates are reduced. Pregnant women from a higher risk group should be screened as early as in the first trimester and referred to specialist clinics for further therapy which helps achieve desired level of the quality of life and effective prophylaxis of possible diabetic complications [10–12].

In Poland an intensive diabetic care program has been implemented for pregnant women with GDM. Hospital departments of gestational pathologies provide diagnosis, prophylaxis, education and treatment which involves patient's individual education. Women are taught how to measure glucose level, how to use glucometer, introduce proper diet and systematically monitor glycemia and the wellbeing of fetus [13].

Patients perceive the news of having GDM in various ways. Their reaction is individual and unforeseeable. Some patients want to get education immediately whereas others do not accept the situation nor take in any information about their disease. Here comes enormous role of diabetological team of professionals who have to establish relationship with patient so that she would follow the recommendations in a reliable and responsible manner. If patient's emotional condition is poor, a psychologist enters the therapeutic process. It is essential that each patient is individually treated, given support to reduce complications for mother and her fetus.

Professional and well-directed education can significantly affect patient's quality of life and giving birth to a healthy baby.

Diabetic diet is the most important in that respect, and many times it is the only method of managing GDM. If pregnant woman follows dietary recommendations, it is possible to maintain glycemia level within the norm over the entire course of pregnancy.

If diabetes is not compensated, insulin has to be introduced as its deficit can lead to fetal death in the uterus. Fetal death is related to metabolic changes and is considered the most dangerous complication to GDM.

Aim of the research

The purpose of study was to evaluate if time of GDM diagnosis and implementation of diabetic care program for pregnant women affect management of glycemia.

Material and methods

There were 383 patients who enrolled in diabetic care program offered by the Clinic of Obstetrics and Gynecology from 15 October, 2010 to 15 January, 2011; 304 patients delivered in hospital, 3 patients miscarried between 17–22 week hbd. There were no multiple pregnancies in the examined group.

Out of the total group 300 patients (78.3%) qualified for the program. Those were the patients whose GDM was diagnosed between 10–12 week hbd on the basis of fasting blood glucose test and patients with

oral glucose tolerance test (OGTT) abnormal results. The parameters analyzed included patient's age, place of living, education, socio-economic status, body mass index (BMI), mean glycemia, week when pregnancy was terminated, method of delivery, neonate's condition after birth (APGAR score). In total there were 749 deliveries over the period of study, 40% of which were patients with GDM.

The patients were divided into 3 groups according to time of GDM diagnosis: group A (10–12 hbd) 46 patients (15% examined), group B (24–28 hbd) 192 patients (64% examined), group C (29 – termination of pregnancy – TP) 62 patients (21% examined).

Results

The patients' age was analyzed in four age groups: < 20 years, 20–30 years, 31–40 years, and > 40 years. The results found correlations between patient's age and time of GDM diagnosis. The results are presented in Table 1.

In group A the biggest group – 24 patients (52.2%) were over 40 years, in group B 116 patients (60.4%) were 31–40 years old, in group C 29 patients (46.8%) were 31–40 years old.

Positive fasting blood glucose test for GDM taken between 10–12 hbd correlated with mother's older age. The biggest group were 158 patients (52.6) from the age group of 31–40 years who tested positively for GDM on OGTT.

The analysis of patients' education revealed differences between the level of education and time of GDM diagnosis. The biggest group were 132 patients (44%) who had higher and 125 patients (41.7%) with secondary education. The GDM was diagnosed only in 2 patients who had junior secondary education.

In group A 31 patients (67.4%) had higher education. In group B the situation was similar to group A: 88 patients (45.8%) had higher and 87 patients (45.3%) had secondary education. In group C 26 patients (42%) had secondary and 21 patients (33.8%) had vocational education. Thus, it seems that patient's education does not influence GDM diagnosis.

Considering the place of living the patients were divided into 2 groups: patients who live in town and patients who live in the country. In group C 38 patients (61.3%) lived the country. In groups A and B bigger number of patients were from town: 31 patients (67.4%) and 167 patients (87%) respectively. Hence comes a conclusion that patients from group C who live in the country go visit their doctors less frequently or delay doing OGTT tests ordered by doctors which affects management of their glycemia.

According to socio-economic status the patients were divided into 3 groups: the respondents who admitted to good, average and poor socio-economic status. The analysis found that socio-economic status significantly affects management of glycemia and the condition of neonate. It was most pronounced in group C where 34 patients (54.8%) admitted to that. Poor socio-economic conditions make patients go to the doctor or do OGTT too late and not follow dietary recommendations. They eat ill-balanced diet containing large amounts carbohydrates and fatty foods. The data are presented in Table 2.

Body mass index was another parameter analyzed. The patients were divided into the following groups: < 18.5 kg/m^2, 18.5–24.9 kg/m^2, 25.0–29.9 kg/m^2 and ≥ 30.0 kg/m^2. The data are presented in Table 3.

The results revealed correlation between GDM diagnosis and BMI. The biggest number of patients with BMI ≥ 30.0 kg/m^2 were from group A 32 patients (69.6%) and C 37 patients (59.7%). The GDM was also frequent in the group of BMI 25.0–29.9 kg/m^2. In group A 10 patients (21.7%) must have had diabetes prior to pregnancy. Higher BMI also correlated with older age of the patients.

The results revealed that GDM was less frequent in the underweight patients and BMI normal. In groups A, B and C there were 4 patients (1.3%) with BMI < 18.5 kg/m^2 and 48 patients (16%) with BMI of 18.5–24.9 kg/m^2.

Optimal physiological weight gain in pregnancy is 10–12 kg. There are many reports on the correlation between BMI and fetal macrosomy. The risk of fetal macrosomy increases at the higher BMI. In obese

Table 1. Patients age in particular groups vs. time of GDM diagnosis

Patients age	Group A (10–12 hbd)		Group B (24–28 hbd)		Group C (29 – to TP)		Total	
	n	%	*n*	%	*n*	%	*n*	%
< 20	3	6.5	6	3.1	2	3.2	11	3.7
20–30	6	13.1	52	27.1	17	27.4	75	25
31–40	13	28.2	116	60.4	29	46.8	158	52.6
> 40	24	52.2	18	9.4	14	22.6	56	18.7
Total	46	100	192	100	62	100	300	100

Table 2. Socio-economic status of patients in particular groups

Status	Group A (10–12 hbd)		Group B (24–28 hbd)		Group C (29 – to TP)		Total	
	n	%	*n*	%	*n*	%	*n*	%
Good	29	63	123	64	12	19.4	164	54.7
Average	14	30.4	62	32.3	16	25.8	92	30.7
Poor	3	6.6	7	3.7	34	54.8	44	14.6
Total	46	100	192	100	62	100	300	100

Table 3. Body mass index at the time of GDM diagnosis in particular groups

BMI [kg/m^2]	Group A (10–12 hbd)		Group B (24–28 hbd)		Group C (29 – to TP)		Total	
	n	%	*n*	%	*n*	%	*n*	%
< 18.5	1	2.2	2	1	1	1.6	4	1.3
18.5–24.9	3	6.5	32	16.7	13	21	48	16
25.0–29.9	10	21.7	93	48.4	11	17.7	114	38
≥ 30.0	32	69.6	65	33.9	37	59.7	134	44.7
Total	46	100	192	100	62	100	300	100

patients, whose pregnancy is complicated by GDM, high BMI at the time of GDM diagnosis and weight gain in pregnancy create a risk of high birth weight of neonate and a bigger number of neonates have hypoglycemia after birth.

Mean level of glycemia was measured fasting blood glucose, 1 h after breakfast, 1 h after lunch, 1 h after supper and at 22:00 o'clock. It was found that time of GDM diagnosis and implementation of diabetic care are closely related to glycemia.

In group B where GDM was diagnosed between 24–28 hbd and diabetic management implemented glucose level normalized as a result of treatment by diet alone. In group A mean fasting blood glucose was high (105 mg/dl). Additionally, mean glucose level measured after meals was above the norm; glucose measured at 22:00 was within the normal range. In group C mean blood glucose measured fasting and after meals was above the norm too (102 mg/dl). It was found to be closely related to socio-economic status: 34 patients (54.8%) assessed their economic status as poor and 16 patients (25.8%) as average.

As the levels of glucose were high, 63 patients (21%) were started on insulin, 14 patients received long-acting insulin Humulin N, the rest were also given short-acting insulin before meals (Humulin R).

In group A 29 patients (46%) were given insulin, in group C 34 patients (54%) received insulin. None of the patients from group B was on insulin.

Considering the week of pregnancy termination the patients with GDM were divided into the following groups: PT < 36 hbd, between 37–39 hbd and > 40 hbd.

Eight patients (2.7%) gave birth prior to 36 hbd. In that group in addition to GDM 3 patients had intrahepatic cholestasis of pregnancy (ICP) and 3 patients suffered from pregnancy induced hypertension (PIH) and 2 patients had cervical incompetence.

In group A 34 patients (74%) delivered between 37–39 hbd, 9 patients (19.5%) delivered on term or post term, 3 patients (6.5%) delivered before term, i.e. before 36 hbd. In that group there were 2 patients with PIH and 1 patient with cervical incompetence. In group B 113 patients (58.9%) delivered either on term of before term, 78 patients (40.6%) between 37–39 hbd and 1 patient (0.5%) delivered before 36 hbd due to cervical incompetence. In group C 32 patients delivered between 37–39 hbd and 26 patients (41.9%) on term or post term, 4 patients (6.5%) delivered before 36 hbd. Three patients suffered from ICP and one had PIH.

The patients who were on insulin therapy the deliveries were induced between 37–39 hbd.

The analysis found that GDM does not affect directly the week of pregnancy termination unless the course of pregnancy is complicated. Then the introduction of insulin therapy results in earlier induction of delivery, i.e. about 38–39 hbd. The method of pregnancy termination in particular groups is presented in Table 4.

Table 4. Type of delivery in particular groups

Parameter	Group A (10–12 hbd)		Group B (24–28 hbd)		Group C (29 – to TP)		Total	
	n	%	*n*	%	*n*	%	*n*	%
Natural delivery	30	65.3	167	87	36	58	233	77.7
Caesarean sections	10	21.7	22	11.5	25	40.4	57	19
Forcepsor Vaccum	6	13	3	1.5	1	1.6	10	3.3
Total	46	100	192	100	62	100	300	100

Table 5. Neonate's clinical condition after birth in particular groups

APGAR	Group A (10–12 hbd)		Group B (24–28 hbd)		Group C (29 – to TP)		Total	
	n	%	*n*	%	*n*	%	*n*	%
0–3 severe	–	–	–	–	–	–	–	–
4–7 medium	19	41.3	12	6.3	35	56.5	66	22
8–10 very good	27	58.7	180	93.7	27	43.5	234	78
Total	46	100	192	100	62	100	300	100

The results revealed a correlation between the type of pregnancy termination and neonate's birth weight. There were 12 patients qualified for elective Caesarean section. In those patients USG determined fetus body weight over 4359 g or the difference between HC to AC more than 4 cm. In group C elective Caesarean sections were performed on 8 patients and in group A in 4 cases. The other Caesarean sections had to be undertaken due to threatening intrauterine fetal asphyxia (28 patients), intrauterine infections (13 patients), prolonged second phase of delivery (1 patient) and maximum straight extension of the fetus head (3 patients).

Surgical termination of all deliveries was due to threatening intrauterine fetal asphyxia.

The condition of neonates was summarily assessed by APGAR score: very good (8–10 points), medium (4–7 points) and severe (0–3 points). The data are presented in Table 5.

No neonate's death nor severe condition was reported in any of the three examined groups.

The risk of neonatal respiratory distress syndrome (RDS) increases at high levels of glycemia. There was only one case of RDS noted in the examined groups. It was a patient from group C who had additional complication of PIH and she delivered before 36 hbd.

Transient tachypnea of the newborn (TTN) is more frequent in diabetes compared to deliveries without diabetic complications. Neonates develop TTN as a result of delayed of pulmonary fluid absorption from the alveoli and respiratory ducts. There were 3 cases of TTN: 2 in group A and 1 in group C. In those cases the newborns were in medium condition. The course of TTN produced moderate gasometric imbalance and certain symptoms of respiratory failure. Clinical symptoms resolved spontaneously within 24 h.

Discussion

The GDM poses a lot of threats for both mother and her baby. To establish proper diagnosis of GDM the period of 24–28 hbd is essential since numerous metabolic changes occur at that time. It is also important to measure fasting blood glycemia between 10–12 hbd. If the result is abnormal, it is highly probable that the patient has had impaired insulin secretion prior to pregnancy.

Early diagnosis of GDM creates a chance of introducing diabetic care program and avoiding or minimizing complications in the course of pregnancy as well as reducing the risk of peri-delivery complications.

In the period between 24–28 hbd the concentration of placental hormones increases. They act as insulin antagonists. In some cases increased requirement for insulin results in higher blood glucose levels.

In the group of 300 patients examined 46 patients had GDM first diagnosed between 10–12 hbd, 192 patients between 24–28 hbd and 62 patients had GDM diagnosed after 29 hbd.

There is an array of factors likely to affect GDM. Patient's age s one of them.

The results found positive correlation between patient's age and GDM diagnosis. The biggest group among them (52.6%) were the patients at the age of

31–40 years. The biggest number of patients from the age group of > 40 years (52.2%) had GDM diagnosed between 10–12 hbd. In group C, too, the biggest group (46.8%) were patients at the age of 31–40 years. Konarzewska *et al*. obtained similar results [4].

The analysis found no correlation between education and GDM.

However, the analysis revealed a relationship between place of living and time of GDM diagnosis, especially in group C. Late diagnosis of GDM was observed among the patients living in the country who go for medical consultation less frequently and do not promptly take tests ordered by doctor.

Moreover, patients' socio-economic condition had a substantial influence on time of GDM diagnosis which was most prominent in group C. In that group 54.8% women admitted to poor socio-economic conditions and that was also connected with the place of living and low education level.

Obesity is one of the most important risk factors of developing GDM. Among the patients with the history of GDM 134 patients (44.7%) had mean BMI > 30.0 kg/m^2 corresponding to obesity. In group A there were 32 patients (69.6%) and in group C 37 patients (59.7%) were obese.

According to Hirnle *et al*. the factors that predispose to GDM include many of well-known symptoms of insulin resistance syndrome [14]. Improper carbohydrate tolerance was significantly more frequent among women with BMI > 25 kg/m^2.

The analysis also included patient's socio-economic status, education, and history of GDM.

Our results are close to Kinalski who investigated similar parameters [15].

The results found that mean blood glycemia measured fasting and after meals was statistically significant in groups A and C. In group A all mean glycemia measurements exceeded the norm. Fasting blood glucose was 105 mg/dl, 1 h after breakfast it was 149 mg/dl, 1h after lunch it was 155 mg/dl, and after supper 146 mg/dl. In group C only one mean value of glycemia measured 1 h after supper was normal. The results suggest that in group A the patients had glucose intolerance before they got pregnant and diet alone was not sufficient to manage glycemia in pregnancy. The results let conclude that time of GDM diagnosis and implementation of diabetic care program have a great influence on glycemia levels. In groups B and C high levels of glycemia were the main cause of administration of insulin therapy.

The analysis revealed that well-managed GDM does not affect the time of pregnancy termination. If there were no other indications, the women delivered on term.

Krasnodębski observed a close correlation between maternal overweight and GDM, and fetus macrosomy. Macorosmy of the fetus results in higher ratio of Caesarean sections performed in the group of pregnant patients with GDM which prevents from expected complications during natural delivery, both to mother and fetus [16].

In the examined group 12 patients from groups A and B were qualified to elective Caesarean section as the predicted birth weight of the fetus was over 4000 g.

Our results found correlation between time of GDM diagnosis and clinical condition of neonate after birth. In group B where diabetic care program was introduced early 93.7% patients gave birth to their babies who were in general good condition and 6.3% patients had babies in medium state. There were no babies who had low APGAR score in that group. In group A 58.7% newborns were born in good condition and 41.3% in medium. Such results were affected by mother's awareness, education, socio-economic status and place of living.

The results obtained by Malinowska-Polubiec were close to ours [17]. Summing up the results, it has to be emphasized that early diagnosis and implementation of diabetic care program aside maintenance of glycemia within normal range by proper diet are most essential for GDM.

Conclusions

There is a correlation between place of living, poor socio-economic status and managing glycemia, which should contribute to developing effective methods of care for women living in those areas. Patients' BMI significantly correlated with fetus macrosomy, which significantly affected the way pregnancy was terminated and neonate's condition after birth. Time of GDM diagnosis has a big influence on glycemia management which is essential for mother's and neonate's health.

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Address for correspondence:

Olga Adamczyk-Gruszka MD, PhD
Department of Obstetrics, Gynecology
and Obstetric-Gynecological Nursing
Faculty of Health Sciences
Jan Kochanowski University
al. IX Wieków Kielc 19, 25-317 Kielce, Poland
Phone: +48 605 233 038
E-mail: kasia.kielce@poczta.fm