



Incisional hernia is a common postoperative complication of abdominal surgery, with the incidence ranging from 11% up to 20% of all laparotomy incisions.

## Pregnant women with pre-existing diabetes mellitus type 2 differ from those with diabetes mellitus type 1

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**RUNNING TITLE** Pre-existing diabetes in pregnant women

**KEYWORDS** diabetes in pregnancy, diabetes mellitus type 2, diabetes mellitus type 1, perinatal outcomes

**WORD COUNT** 1 963

**CONFLICT OF INTERESTS** no conflicts of interest

### ABSTRACT

**Background:** Type 2 diabetes has reached epidemic proportions in recent years. The aim of this study was to compare perinatal outcomes in type 2 and type 1 diabetic patients.

**Materials and Methods:** Maternal and fetal outcomes were compared between 62 pregnant women with type 2 pregestational diabetes mellitus and 448 pregnant women with type 1 diabetes who delivered in the University Hospital of Warsaw from 2000 to 2011.

**Results:** Women with type 2 diabetes were older, more overweight prior to pregnancy (BMI 29.3 vs 24.2 kg/m<sup>2</sup>,  $p < 0.0001$ ), gained less weight during pregnancy and presented with hypertension during pregnancy. The patients with type 2 diabetes exhibited lower 1-hour postprandial glycemia levels (104.7 vs 117.4 mg/dL,  $p < 0.001$ ) in the 3rd trimester and lower mean glycemia levels during labor (89.9 vs 107.8 mg/dL,  $p < 0.001$ ). The durations of the pregnancies of these patients were significantly longer (37.1 vs 36.3 weeks,  $p < 0.05$ ). Neonates of mothers with type 2 diabetes were significantly less likely to exhibit low 1st-minute Apgar scores (3.6% vs 18.1%,  $p < 0.05$ ).

**Conclusions:** Pregnant women with type 2 diabetes mellitus present with more risk factors for metabolic syndrome such as hypertension and obesity and exhibit better metabolic control during the 3rd trimester of pregnancy.

## BACKGROUND

**P**regestational diabetes mellitus (PGDM) affects less than 1% of the obstetric population [1] but is a significant cause of maternal and fetal morbidity and mortality [1,2,3,4,5]. It is known that the risks of maternal and fetal complications due to pregestational diabetes can be reduced by optimal metabolic control from preconception to delivery [6,7,8,9].

The prevalence of type 2 diabetes mellitus is increasing worldwide [10,11,12]. Additionally, pregnant women tend to be older and overweight and are more likely to present with type 2 diabetes [13]. Pregnant women with pregestational type 2 diabetes are less likely to exhibit glycemic disturbances but do not seem to have better outcomes than those with type 1 diabetes [14].

The aim of the study was to compare maternal and fetal outcomes in women with types 2 and 1 PGDM who delivered in a university hospital during a 12-year period.

## MATERIALS AND METHODS

We performed a retrospective analysis of patients with PGDM who delivered live-born infants in the 2nd Department of Obstetrics and Gynecology of the Medical University of Warsaw, Poland from the 1st of January 2000 to the 31st of December 2011. Of the 510 singleton deliveries by women with PGDM, 62 (12.2%) of the mothers suffered from type 2 diabetes, and 448 suffered from type 1 diabetes. Type 2 diabetes was defined according to the WHO criteria [15], and no insulin therapy had been used for at least 1 year after diagnosis in these patients. Fifteen women with PGDM type 2 required only dietary treatment before pregnancy, and 4 of these women required insulin therapy during pregnancy. Forty-seven women with PGDM type 2 required oral glucose-lowering drugs before pregnancy, and in cases of planned pregnancies, they were transitioned to multiple daily doses of insulin therapy. If the pregnancy was not planned, these patients were given this therapy beginning during the first prenatal visit. Four hundred forty-eight women with PGDM type 1 were treated with insulin before and during pregnancy. Ninety-five patients with PGDM type 1 received continuous subcutaneous insulin infusions (CSII). All subjects were Caucasian and lived in the central part of Poland. The following therapeutic targets were defined: a fasting blood glucose of 60–95 mg/dL, a 1-hour postprandial glucose of 60–140 mg/dl, and an HbA1c < 6.1%.

Examined maternal characteristics included age, parity, obstetric history, anthropometric parameters, and gestational weight gain. Examined characteristics of maternal diabetes in pregnancy included the onset and duration of diabetes, the class of PGDM according to the White classification, the mean

fasting and 1-hour postprandial glucose levels in the 3rd trimester and the mean labor glucose level (table 1).

The following current pregnancy data were compared: the time of the first prenatal visit, the presence of pre-pregnancy hypertension (PPH) or pregnancy-induced hypertension (PIH), proteinuria, cholestasis, anemia, threatened miscarriages or threatened pre-term births, polyhydramnios, genital and urinary tract infections, thyroid disorders, and intrauterine deaths.

Examined delivery data included gestational age, fetal parameters before delivery, labor induction, the delivery method, labor duration for vaginal deliveries, the use of epidural anesthesia in vaginal deliveries, and shoulder dystocia (table 2).

Neonatal outcomes examined included sex, birth weight and length, head, abdominal and chest circumference, shoulder width, 1st minute and 5th minute Apgar scores, neonatal injuries, perinatal hypoxia, hyperbilirubinemia requiring phototherapy, abnormal neurological symptoms, respiratory disorders, infection, admission to the neonatal intensive care unit (NICU), birth defects and neonatal mortality. Umbilical cord blood gases were also assessed (table 3).

Statistical analyses were performed using a chi-squared test and by comparisons of means and medians. Analysis of variance was used when appropriate to evaluate differences in continuous variables between the groups. P-values below 0.05 indicated statistical significance.

## RESULTS

The Women with PGDM type 2 were older at delivery and were more often overweight before pregnancy. These women gained less weight during pregnancy, and the majority were class A or B (96.8%) according to the White classification. Only 0.4% of women with PGDM type 1 were class A, and 42.2% were class B. The onset of diabetes in women with PGDM type 2 occurred later in life, and the duration was shorter. These women exhibited better glycemic control in the 3rd trimester; the mean fasting glucose levels were 89.1 and 97.7 mg/dL. The mean 1-hour postprandial glucose levels were 104.7 and 117.4 mg/dL, and the mean labor glucose levels were 89.9 and 107.8 mg/dL in women with PGDM type 2 and type 1, respectively (table 1).

There was no difference between the groups in the time of the first prenatal visit. No differences were observed in the incidences of pregnancy complications, with the exception of hypertension, which was present twice as often in pregnant women with type 2 diabetes (45.2% vs 24.6%,  $p < 0.005$ ). A significant difference was found in the frequencies of pre-pregnancy hypertension. There were seven intrauterine deaths among pregnant women with type 1 diabetes. The duration of pregnancy was significantly longer in pregnant women with PGDM type 2; 16.0% of

women with PGDM type 2 and 26.0% of women with PGDM type 1 delivered prior to 37 weeks. No significant differences were found between the groups in the prepartum fetal biometric parameters. Pregnant women with type 2 diabetes more often required labor induction and were more likely to deliver spontaneously (53.2% vs 26.6%,  $p < 0.001$ ) (table 2). No differences in sex, birth weight, abdominal circumference or shoulder width were observed between the neonates of mothers with PGDM type 2 and the neonates of mothers with PGDM type 1. The neonates of type 2 diabetic mothers were significantly less likely to exhibit low 1st-minute Apgar scores (below 7 points) (3.6% vs 18.1%,  $p < 0.05$ ). With respect to early neonatal complications, no differences were observed (table 3). The perinatal mortality rate in the PGDM type 1 group was 2.23%. Of these, two children were extremely premature, and one was premature. There were no perinatal deaths in the PGDM type 2 group.

## DISCUSSION

The incidence of type 2 diabetes in pregnancy has increased in many regions [16,17]. In our university center, the first women with type 2 diabetes during pregnancy were observed in 2004, and the frequency of women with type 2 diabetes increased from 14.3% in 2004 to 20.3% in 2011. Pregnancy is a period in the lives of women in which disturbances in carbohydrate metabolism may appear for the first time [18,19]. Predispositions to hypertension may be revealed during gestation as pregnancy-induced hypertension.

Hypertension and obesity are the primary risk factors for metabolic syndrome and cardiovascular disease. In the present study, women with PGDM type 2 presented more often with risk factors for cardiovascular disease such as hypertension and obesity. Hypertension appeared twice as often in type 2 mothers than the type 1 mothers and involved nearly half of the pregnancies in the former. Many authors have confirmed that hypertensive disorders are 2 to 4 times more common in women with type 2 diabetes than in non-diabetic women [20]. Diabetes increases the risks of angiopathy and cardiovascular disorders. Rasmussen et al. concluded that despite the low risk of progression of retinopathy in pregnant women with type 2 diabetes, sight-threatening deterioration did occur [21].

A recent Danish registry-based cohort study analyzed the risks of both subsequent cardiovascular morbidity and type 2 diabetes mellitus in women with previous hypertensive pregnancy disorders [22]. After a 14.6-year follow-up, the authors found that hypertensive pregnancy disorders were strongly associated with the subsequent development of type 2 diabetes and hypertension and that the latter occurred independently of type 2 diabetes mellitus. The risk of subsequent hypertension was increased

more than 5-fold following pregnancy-induced hypertension. A systematic review and meta-analysis of 25 cohort studies (almost 3.5 million women) confirmed the associations of pre-eclampsia with hypertension and other cardiovascular events. Other studies have found increased frequencies of sub-clinical features of metabolic syndrome following pre-eclampsia. Minimal data exist regarding follow-ups of hypertensive disorders in diabetic pregnancies [20].

In our study, pregnant women with PGDM type 2 were more frequently overweight prior to pregnancy than women with PGDM type 1. Data have shown that pregnant women with type 2 diabetes tend to be heavier and older [23,24].

Many authors have found that glycemic control, particularly in the first trimester, is better among women with type 2 diabetes than women with type 1 diabetes [23,24,25]. Cyganek et al. [23] demonstrated a significant difference in HbA1c in the first trimester between women with type 2 and type 1 diabetes, but these differences were not significant in the second or third trimesters. Our data demonstrated improved glycemic control in the third trimester in women with type 2 diabetes. We have insufficient data concerning glycemic control before pregnancy. In both groups, the average time of the first prenatal visit was the 10th week. We observed that the percentages of congenital malformations were similar in both groups and affected approximately 15% of neonates. A 16.9% rate of malformations was reported by Towner et al. [26] among 332 infants born to type 2 diabetic women who were given no preconception counseling and were treated with dietary restrictions, insulin or sulfonylureas for at least the first 8 weeks of gestation. Even among type 2 pregnant women, who exhibit better glycemic control than their type 1 counterparts, the rate of major fetal malformations has been reported to be twice as high as that reported among their type 1 counterparts and the general population (RR 2.3, 95%CI: 0.9–6.0) [27].

In our study, the frequency of LGA infants was higher (above 20%) than that reported in another Polish study [23], which found that macrosomia affected only 8% of neonates with mothers with type 2 diabetes and 17% of those with mothers with type 1 diabetes. Much higher prevalences of macrosomia (approximately half) were reported in the studies from Denmark [27] and the United Kingdom [28].

Regarding perinatal mortality, papers published thus far have presented a confusing picture, with frequencies in different countries ranging from 1.1 to 17%; however, these frequencies are always higher than those in the general population [29]. Clausen reported a higher frequency of perinatal mortality in type 2 diabetic women than type 1 diabetic women (RR 8.9, 95%CI: 3.4–23.0) [27]. This finding was confirmed in an Italian multicenter study [24] and by Cundy et al. [30]. The latter study reported a significantly



higher perinatal mortality rate in type 2 cases than in type 1 cases or the general population (46/1000 vs 12.5/1000, and 12.5/1000, respectively) and an increase in the frequency of late fetal death [30].

## CONCLUSION

Pregnant women with type 2 diabetes mellitus more frequently present with risk factors for metabolic syndrome such as hypertension and obesity. These patients also exhibit better metabolic control during the 3rd trimester of pregnancy.

## CITE THIS AS

MEDtube Science 2016, Mar 1(4), 14-20.

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