International Journal of Diabetes in Developing Countries (January–March 2025) 45(1):120–125
https://doi.org/10.1007/s13410-024-01333-5

ORIGINAL ARTICLE

Maternal and neonatal outcomes of deliveries at 39 weeks compared to deliveries at 40 weeks in pregnant women with diet controlled gestational diabetes mellitus

Mohammadali Shahriari[1] · Ali Shahriari[2] · Maryam Khooshide[3] · Zeynab Nouraei[3] · Ali Montazeri[4] · Rana Karimi[3,5]

Received: 21 August 2022 / Accepted: 28 March 2024 / Published online: 6 April 2024

Abstract

Objective Current guidelines do not provide convincing conclusions for the ideal time of delivery in women with diet-controlled gestational diabetes mellitus (GDM). We aim to compare maternal and neonatal outcomes of deliveries at 39 weeks compared to deliveries at 40 weeks in pregnant women with diet-controlled gestational diabetes mellitus.

Methods This prospective observational cohort study included 219 pregnant women with diet-controlled gestational diabetes who delivered at 39 weeks (106 patients) or 40 weeks (113 patients) in our center from January 2017 to January 2018. Maternal and neonatal characteristics and outcomes were collected and compared between these two groups based on gestational age.

Results There was no statistically significant difference between these two groups in delivery mode ($p=0.581$), macrosomia (6.6% vs. 10.6%, $p=1$). The rate of postpartum hemorrhage, uterine atony, and perineal laceration (3rd and 4th grades) of the study groups was not significantly different. Considering neonatal outcomes, there were no significant differences in the incidence of intrauterine growth restriction, low Apgar score, neonatal intensive care unit admission, and thick meconium between two groups ($p>0.05$). The incidence of shoulder dystocia and preeclampsia in women who delivered at 40 weeks was slightly higher than in women who delivered at 39 weeks (0% vs. 3.5% ($p=0.122$) and 2.8% vs. 9.7% ($p=0.051$), respectively). Neither of these differences was statistically significant.

Conclusion There were no statistically significant differences in maternal and neonatal adverse outcomes in women with diet-controlled gestational diabetes who delivered at 39 weeks compared to women who delivered at 40 weeks. However, the observed higher rate of shoulder dystocia and preeclampsia among women who delivered at 40 weeks might need to be investigated further in larger studies while it might indicate the need for iatrogenic intervention at 39 weeks.

Keywords Maternal outcomes · Neonatal outcomes · Gestational diabetes mellitus · Cesarean delivery · Dystocia · Preeclampsia

✉ Rana Karimi
rkarimi@sina.tums.ac.ir

[1] School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

[2] Department of Anesthesiology, Tehran University of Medical Sciences, Tehran, Iran

[3] Department of Obstetrics and Gynecology, Arash Women's Hospital, Tehran University of Medical Sciences, Tehran, Iran

[4] Health Metrics Research Centre, Institute for Health Sciences Research, ACECR, Tehran, Iran

[5] Research development center, Arash Women's Hospital, Tehran University of Medical Sciences, Rashid Ave, Ressalat Highway, Tehranpars, P.O Box: 0098211653915981, Tehran, Iran

Introduction

Gestational diabetes mellitus (GDM) is one of the most common complications in pregnancy with a great threat to maternal and neonatal health [1–3]. The prevalence of gestational diabetes varies from 1 to 28% in pregnancy [4, 5]. This substantial variation in the prevalence of GDM is mostly related to study characteristics such as geographical area, population, data collection methods, sampling methods, and applied diagnostic criteria [5]. In Iran, the prevalence of GDM is reported to vary from 1.3 to 18.6% [6].

GDM is associated with an increased risk of adverse perinatal outcomes. A pregnant woman with GDM is at risk of intrauterine fetal demise (IUFD), preeclampsia, operative deliveries, cesarean delivery, and uterine atony [7]. Neonates of women with GDM are at increased risk of macrosomia, neonatal death, and birth trauma including shoulder dystocia and Erb's palsy [7].

Pregnant women with GDM are classified into two classifications: Gestation diabetes with glycemic control achieved without medication or diet-controlled gestational diabetes mellitus also known as type A1 gestational diabetes mellitus (A1GDM) and gestation diabetes with glycemic control achieved with medication (A2GDM) (ACOG 2018, Berger 2019, Yin 2022).

Decision regarding the optimal timing of delivery depends on the classification of the gestational diabetes and adequacy of the glycemic control. Also, this decision should be made on a case-by-case approach with balancing obstetrical complications, neonatal complication, and risk of IUFD.

There are consistent recommendations for timing of delivery in pregnant women with A2GDM. There is a general consensus that for pregnant women with uncomplicated GDM and good glycemic control, birth should not be planned before 39 + 0 weeks of gestation or after 41 + 0 weeks [8, 9].

However, current different guidelines do not provide convincing conclusions for the ideal time of delivery in women with diet-controlled gestational diabetes mellitus (A1GDM). Different studies used in these guidelines provide a broad range for optimal time of delivery. Moreover, these studies have limitations such as sample size, study design, and patient's characteristics [10–12].

We aim to compare maternal and neonatal outcomes of deliveries at 39 weeks compared to deliveries at 40 weeks in pregnant women with diet-controlled gestational diabetes mellitus.

Methods and materials

Study design

This is a prospective cohort study on women with singleton pregnancy who were diagnosed with A1GDM after they have been diagnosed with A1GDM and were referred to our prenatal care clinic at Arash Women's Hospital (Tehran, Iran) from January 2017 to January 2018.

The inclusion criteria include singleton pregnancy with the gestational age of 28 weeks and older based on the first day of the last menstrual period and the first-trimester ultrasound. All enrolled individuals had confirmed diagnosis of gestational diabetes with 75-g glucose tolerance test or 100-g glucose tolerance test. None of the enrolled individuals had use of oral medications or insulin for glycemic control until 28 weeks of gestation and remained solely on a diabetic diet for the management of gestational diabetes. Exclusion criteria included women with a history of pre-pregnancy diabetes, multiple gestation, breech presentation of fetus, history of IUFD or IUFD in the current pregnancy, history of previous cesarean delivery, chronic hypertension, intrauterine growth retardation (IUGR) in current pregnancy, co-occurrence of preeclampsia, placenta previa, placenta accrete, fetal malformations, and maternal or fetal conditions requiring preterm delivery.

Procedure

We used self-monitoring of blood glucose measurements to assess glycemic control as recommended by the ADA [13]. Patients enrolled in the study were instructed to record self-monitored of blood glucose measurements four times per day: fasting blood glucose and 2 h after breakfast, lunch, and dinner. Fetal growth was assessed using ultrasound at 32 and 36 weeks of gestation. Patients who were not able to check their blood glucose tests daily at home were advised to check their fasting blood glucose and 2-h postprandial blood glucose tests every 2 weeks. Optimal glycemic control was defined based on ADA targets: less than 95 mg/dl for fasting and less than 120 mg/dl for 2-h postprandial glucose [14]. If optimal glycemic control is not achieved over a 2-week period, the gestational diabetes treatment plan is intensified and the patient was excluded from the study. Also, in case of delivery earlier than 39 weeks of gestation, the participant was excluded from the study. All enrolled individuals (mothers and infants) were followed up until the time of discharge from the hospital.

We compared maternal and neonatal outcomes between women who delivered at 39 weeks of gestation with women who delivered at 40 weeks of gestation.

Outcomes

Outcomes were categorized into maternal outcomes and neonatal outcomes. Maternal outcomes included pregnancy-induced hypertension (PIH), preeclampsia, uterine atony, 3th or 4th degree perineal laceration, and postpartum hemorrhage (defined as hemoglobin decreased ≥ 2 g/dl after delivery), induction of labor, and method of delivery. Neonatal outcomes included shoulder dystocia, macrosomia, IUGR, thick meconium, fetal distress (defined as Apgar score less than 3 and 7 at 1 min and 5 min after delivery, respectively), neonatal intensive care unit (NICU) admission, and IUFD. The presence of shoulder dystocia was assessed by means of a standardized checklist completed by the obstetrics and gynecology physician specialist who was present at the time of delivery.

Sample size

The sample size was calculated based on a 10% clinical difference in the main outcome variable (the incidence of cesarean delivery) between women who delivered at 39 weeks and women who delivered at 40 weeks. The cesarean delivery in the 39-week delivery group (Group A) and 40-week delivery group (Group B) were considered 20% and 10%, respectively. The significance α level was set at 5% (95% confidence interval = 1.96), and the power of the study (β level) was set at 80%. Considering the design effect of 1.5 ($D = 1.5$), we planned to enroll a total of 300 participants (150 women per group).

A total of 303 women were enrolled in the study. Eighty-two women who delivered before 39 weeks of gestation were excluded from the study (30 delivered at 38 weeks and 52 women delivered at 37 weeks).

Data analysis

Data were analyzed using descriptive statistics including means and frequencies. Demographic and clinical baseline variables of the two groups were compared using an independent *t*-test and chi-squared test. The p-value < 0.05 was considered statistically significant.

All data were extracted and tabulated. Results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by absolute frequencies and percentages for categorical variables. Categorical variables were compared using chi-square test. Quantitative variables were compared using *t*-test. *p*-values of 0.05 or less were considered statistically significant.

Results

In addition, two participants were excluded due to IUFD during the follow-up period and lack of appropriate glycemic control with diet which necessitated insulin therapy. The data analysis was performed for the remaining 219 participants (Group A: 106 individuals and Group B: 113 individuals). Except for age, there was no statistically significant difference between group A and group B considering the demographic characteristics including gravidity, parity, and body mass index (BMI) (30 ± 5.9 years vs. 28 ± 5.7 years, respectively). Demographic characteristics for all patients by gestational age at the time of delivery are summarized in Table 1.

Maternal outcomes

Table 2 shows a comparison of maternal outcomes between the two groups based on the gestational age at the time of delivery.

There was no statistically significant difference in rate of PIH (23.6% vs. 16.8%), preeclampsia (2.8% vs. 9.7%), postpartum hemorrhage (18.9% vs. 19.5%), induction of labor (78.3% vs. 83.2%), cesarean delivery (45.5% vs. 38.1%), perineal laceration (0.9% vs. 0.9%), and uterine atony (9.4% vs. 11.5%) between Group A and Group B.

Of note, the incidence of preeclampsia in women who continued the pregnancy after 40 weeks of gestation was 3.5 times higher than in women who delivered at 39 weeks of gestation. However, this difference was not statistically significant.

Neonatal outcomes

Table 3 presents a comparison of neonatal outcomes between the two groups based on the gestational age at the time of delivery.

There was no statistically significant difference in rate of thick meconium (15.1% vs.13.3%), birth weight (3324 ± 494 g vs. 3439 ± 490 g), macrosomia (6.6% vs. 10.6%), IUGR (0.9% vs. 0.9%), NICU admission (2.8% vs. 2.7%), shoulder dystocia (0 vs. 3.5%) between Group A and Group B.

Table 1 Comparison of demographic characteristics of participants by gestational age at the time of delivery

	Total (N = 219) N (%)	Group A (N = 106) N (%)	Group B (N = 113) N (%)	*p*-value
Gravidity				0.81
1	100 (45.7%)	48 (45.3%)	52 (46%)	
2	59 (26.9%)	27 (25.5%)	32 (28.3%)	
≥ 3	60 (27.4%)	31 (29.2%)	29 (25.7%)	
Parity				0.67
0	129 (58.9%)	63 (59.4%)	66 (58.4%)	
1	52 (23.7%)	27 (25.5%)	25 (22.1%)	
≥ 2	38 (17.4%)	16 (15.1%)	22 (19.5%)	
Age (mean ± SD)	29.1 ± 5.8	30 ± 5.9	28 ± 5.7	0.004
BMI (mean ± SD)	30.6 ± 5	30.9 ± 5.1	30.2 ± 4.8	0.348

Table 2 Comparison of maternal outcomes by gestational age at the time of delivery

	Group A (N = 106) N (%)	Group B (N = 113) N (%)	p-value
Pregnancy induced hypertension			0.24
Yes	25 (23.6%)	19 (16.8%)	
No	81 (76.4%)	94 (83.2%)	
Preeclampsia			0.051
Yes	3 (2.8%)	11 (9.7%)	
No	103 (97.2%)	102 (90.3%)	
3th or4th degree perineal laceration			1
Yes	1 (0.9%)	1 (0.9%)	
No	105 (99.1%)	112 (99.1%)	
Uterine atony			0.664
Yes	10 (9.4%)	13 (11.5%)	
No	96 (90.6%)	100 (88.5%)	
Postpartum hemorrhage			1
Yes	20 (18.9%)	22 (19.5%)	
No	86 (81.1%)	91 (80.2%)	
Induction of labor			0.394
Yes	83 (78.3%)	94 (83.2%)	
No	23 (21.7%)	19 (16.8%)	
Mode of delivery			0.581
Vaginal	61 (57.5%)	70 (61.9%)	
Cesarean delivery	45 (45.5%)	43 (38.1%)	
Cause of cesarean delivery			0.61
Full arrest	5 (11.1%)	5 (11.6%)	
Fetal distress	20 (44.4%)	18 (41.8%)	
Macrosomia	3 (6.8%)	5 (10.6%)	
Failure to progress	17 (37.7%)	15 (35%)	

The incidence of Apgar scores of less than 3 at 1 min and less than 7 at 5 min after delivery was not statistically different between the two groups (1.9% vs. 1.8%).

Discussion

Our findings suggest that in this study population, there is no statistically significant difference in rate of a composite of maternal and neonatal outcomes between pregnant women with diet-controlled gestational diabetes who delivered at 39 and women at 40 weeks Although our data failed to identify a statistically significant difference in rate of maternal and neonatal outcomes between these two groups, the rate of some of the outcomes such as preeclampsia, dystocia, and uterine atony needs to be interpreted more cautiously.

The rate of cesarean delivery in this cohort of patient (42.1%) was significantly higher than the rate of primary or secondary cesarean delivery in women with the same gestational age at the time of delivery in the United States (18.2%). However, this rate is similar to the previously reported rate of cesarean delivery in Iran [15–17].

The high rate of cesarean delivery and induction of labor might have contributed to the reduction in serious neonatal outcomes. These study participants had appropriate glycemic control based on the monitoring which was performed every 2 weeks which probably was because of the combination of diet and nutritional education modifications.

The best recommended type of exercise intervention and dietary modifications remain controversial. Current evidence suggests that adherence to dietary modifications and exercise during pregnancy, not only improves the glycemic control but also might reduce risk of cesarean delivery. However, no high-quality data demonstrated its role in reduction of hypertensive disorders of pregnancy, perinatal mortality, macrosomia, perineal trauma, neonatal hypoglycemia, and childhood adiposity. The evidence concerning the type of physical exercise or dietary regimen characteristics which are most effective is fragmented and inconsistent [18].

Table 3 Comparison of neonatal outcomes by gestational age at the time of delivery

	Group A ($N=106$) N (%)	Group B ($N=113$) N (%)	*p*-value
IUGR			1
Yes	1 (0.9%)	1 (0.9%)	
No	105 (99.1%)	112 (99.1%)	
Shoulder dystocia			0.122
Yes	0	4 (3.5%)	
No	106 (100%)	109 (96.5%)	
Thick meconium			0.847
Yes	16 (15.1%)	15 (13.3%)	
No	90 (84.9%)	98 (86.7%)	
Macrosomia			0.29
Yes	7 (6.6%)	12 (10.6%)	
No	99 (93.4%)	101 (89.4%)	
Apgar score less than 3 at 1 min			1
Yes	2 (1.9%)	2 (1.8%)	
No	104 (98.1%)	111 (98.2%)	
Apgar score less than 7 at 5 min			1
Yes	2 (1.9%)	2 (1.8%)	
No	104 (98.1%)	111 (98.2%)	
NICU admission			1
Yes	3 (2.8%)	3 (2.7%)	
No	103 (97.2%)	110 (97.3%)	

Several factors impact the timing of delivery in women with GDM. As a consensus, in the absence of an indication for early delivery, GDM with appropriate glycemic control with dietary modifications should not be considered the solo reason for early delivery while the continuation of pregnancy might improve fetal outcome [19]. These recommendations are compatible with our findings.

However, as reported by some other investigators, early induction of labor at 38 weeks gestation in women with diet-controlled GDM reduces the risk of stillbirth, maternal death, and cesarean section compared to women who delivered after 39 weeks of gestation [7].

While pregnant women with the expectant management are more likely to deliver neonates who weigh more than the 90th percentile, this does not necessarily translate into a higher rate of obstetrical poor outcomes such as cesarean delivery, shoulder dystocia, neonatal hypoglycemia, or perinatal deaths. The role of the health care provider, delivery setting, and maternal characteristics role needs to be considered in the interpretation of these findings [20, 21].

Given the low incidence rate of some of the maternal and neonatal outcomes, it is apparent that a larger sample size might be able to precisely detect the small difference between these outcomes. Furthermore, it should be noted that the difference in rate of these outcomes or presence of correlation does not necessarily reflect causation.

In this study, we did not examine the reason for the induction of labor in our patients. However, more than 80% of these study participants underwent induction of labor. This rate is higher than the previously reported rate of induction of labor in studies which were performed in Iran (43–53%) [22]. The remarkable difference of these rates with the rate induction of labor in the United States (23%) needs to be studied more extensively [23].

In our study, we evaluated the outcomes of newborns up to the moment of birth, and unfortunately, we do not have data about the blood glucose status of newborns and also the status of newborn jaundice and this problem was one of the limitations of our study and it is recommended that the blood glucose status of the newborn and neonatal jaundice be considered in the next studies.

It is worth emphasizing that given the heterogenous nature of the gestational diabetes mellitus, a personalized patient-centered approach to decide the safe delivery timing which is focused on shared decision-making with considering patient's individual characteristics will remain the mainstay of approach to the timing of delivery.

Conclusion

Based on our study findings, the rate of adverse maternal or neonatal outcomes was not different between women with diet-controlled gestational diabetes who delivered at 39 weeks compared to women who delivered at 40 weeks.

However, the observed higher rate of shoulder dystocia and preeclampsia among women who delivered at 40 weeks might need to be investigated further in larger studies while it might indicate a need for iatrogenic intervention at 39 weeks. We suggest that the association between timing of delivery and rare outcomes be examined in the future multicenter studies with a more diverse cohort of patients to determine the risk of rare adverse events more precisely.

Author contribution All authors contributed to the study conception and design. Material preparation and data collection were performed by Mohammadali Shahriari, Ali Shahriari, Maryam Khooshide, and Zeynab Nouraei. Data analysis was performed by Ali Montazeri. Interpretation of the finding results was performed by Maryam Khosshide and Rana Karimi. The first draft of the manuscript was written by Rana Karimi and all authors reviewed and revised previous versions of the manuscript. All authors read and approved the final version of the manuscript.

Declarations

Conflict of interest The authors declare no competing interests.

Ethics approval The institutional review board and ethics committee of Tehran University of Medical Sciences (Tehran, Iran) approved the study (IR.TUMS.MEDICINE.REC.1396.3658). Written informed consent was obtained from all participants.

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