Original Article

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Outcome of newborns with diabetic mothers

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ABSTRACT

Background: Diabetes mellitus (DM) is a metabolic disease that can affect pregnant women; if diabetic mothers are not well controlled, newborns may face higher risks of serious problems during pregnancy and at birth. **Methods**: This study was a cohort follow-up study that assessed the outcome of infants born to diabetic mothers (IDM). It involved two groups: a study group of 77 IDM (45 males and 32 females) born at Basra maternity and Children Hospital during the set six-month period (January 1 to June 30, 2018) and a control group of 137 infants born to non-diabetic mothers (69 males and 68 females) during the same period. Both groups were followed up to 28 days of life (the neonatal period). **Results**: The study results showed that the rates of preterm birth, macrosomia, respiratory distress syndrome, and hyperbilirubinemia were significantly higher among IDM (14.3%, 41.6%, 13%, and 10.4%, respectively) than among infants of non-diabetic mothers (5.1%, 5.8%, 0.7%, and 0.7%, respectively), with a p-value of <0.05. Additionally, a p-value rate of congenital malformations among IDM was higher than that among non-diabetic mothers (6.5% vs. 0.7%). The study also revealed that the most common metabolic disorder affecting IDM was hypoglycemia, which affected 40.3%, while neonatal death among IDM was 4%, compared to 0.77% for infants of non-diabetic mothers (causes of death included two due to preterm birth and one due to congenital heart disease). **Conclusion**: The results of the present study suggest that preterm birth, macrosomia, respiratory distress syndrome, hyperbilirubinemia, and hypoglycemia are significantly associated with diabetes during pregnancy. Hence, family planning, preconception counseling, and special antenatal care are recommended for diabetic mothers to reduce the risk of infant morbidity and mortality.

Keywords: Infants of diabetic mothers, gestational diabetes, neonatal Outcomes, antenatal Care.

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INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia, resulting from a complex interaction of genetic and environmental factors. Depending on the etiology of DM, factors contributing to hyperglycemia include reduced insulin secretion, increased glucose production, and insulin resistance.[1]

Type 1 diabetes accounts for approximately 10% of the adult diagnosed diabetic population and can occur at any age, while type 2 diabetes accounts for 90% of

adults with diabetes, which usually occurs in individuals over the age of 30 with a family history of the disease.[2]

The presence of maternal DM during pregnancy has consequences for both the mother and child.[3] Diabetes is one of the most common medical complications affecting pregnancy; it complicates 0.5% to 5% of all pregnancies.[2] The increase in diabetes rates in the overall population could lead to a higher rate of pregestational diabetes (PGD), placing more women and fetuses at risk.[4]

MATERIALS AND METHODS

This cohort follow-up study was conducted in the neonatal unit, obstetric wards, and labor room at Basra Maternity and Children Hospital. The study group consisted of 77 IDM (45 males and 32 females) over six months (from January 1 to June 30, 2018). The control group consisted of 137 infants born to non-diabetic mothers (69 males and 68 females) who were born in the same hospital during the same study period. The study and the control groups were matched for maternal age and mode of delivery. Both groups were followed up until the end of the neonatal period (i.e., up to 28 days of age). Data for this study were collected using a researcher-made questionnaire that asked about the type of DM, type of treatment, antenatal care, HbA1C for the mothers, and compliance with treatment. Other variables included obstetric history (parity categorized into primiparous, 2–4, and > 5), history of abortion (grouped into non-abortion, one abortion, and two or more)[5], history of stillbirth (i.e., a fetus born with no signs of life after 24 weeks of gestation)[6], and history of neonatal death (i.e., the death of a live-born infant from birth up to 28 days)[7]. Gestational age was categorized into preterm (<37 weeks), term (37–42 weeks), and post-term (>42 weeks).[8] Birth weight was classified into macrosomia (birth weight > 4000 g), normal weight (2500 g to 3999 g), and low birth weight (<2500 g).[9,10] In addition, all IDMs underwent the following investigations: blood glucose level (hypoglycemia was considered when blood sugar was <45 mg/dl), serum calcium (hypocalcemia when total serum calcium was <7 mg/dl), and polycythemia (hematocrit >65%).[11] Jaundice was defined as any hyperbilirubinemia requiring treatment, and chest radiographs and echocardiography were also performed. More information was collected through direct interviews with mothers after obtaining their verbal consent to participate in the study. Some data were derived from the clinical records of mothers and infants (records kept in the obstetric wards and NICUs). At the end of the follow-up period, additional data were derived from the interview with mothers via telephone calls or the clinical records if death occurred in the NICU.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) Version 17. Comparisons of proportions were conducted using crosstabulation with the Chi-square test (X^2). A p-value of <0.05 was considered statistically significant.

RESULTS

The most common type of gestational diabetes mellitus (GDM) was found in 61% of cases, and the predominant type of treatment was insulin therapy (68.8%). (Table 1)
The most common age group was the one between 30 and 39 years old, having a prevalence of 53.2% and 55.5% in the study and control groups, with no significant difference in their distribution regarding maternal age (p-value > 0.05). (Table 2).
This study also showed that the most common mode of delivery was emergency CS (44.1%, 48.9% for the control group), with no significant difference between the two groups (p-value > 0.05). (Table 3)

Table 1: Type of diabetes and treatment in diabetic mothers.

Type of DM	Number of cases	%
GDM	47	61
Type 1	6	7.8
Type 2	24	31.2
Type of treatment		
Insulin	53	68.8
Diet alone	17	22.1
Oral hypoglycemic agent	7	9.1
Total	77	100

Table 2: Distribution of the study and control groups according to maternal age.

Variable	Study group		Control group	
Maternal age	No.	%	No.	%
< 20	3	3.9	6	4.4
20-29	25	32.5	45	32.8
30-39	41	53.2	76	55.5
>40	8	10.4	10	7.3
Total	77	100	137	100
p-value = 0.889				

Table 3: Distribution of the study and control groups according to mode of delivery.

Mode of delivery	Study group		Control group	
Emergency CS	34	44.1	67	48.9
Elective CS	30	39	50	36.5
Vaginal delivery	13	16.9	20	14.6
Total	77	100	137	100
p-value = 0.789				

The study and control groups were comparable with respect to parity, showing no significant statistical difference (p-value > 0.05). A significantly higher percentage of mothers in the study group (31.2% had one abortion and 13% had two or more) compared to those in the control group (21.2% had one abortion and 5.8% had two or more) reported a previous history of abortion (p-value < 0.05). Conversely, there was no significant difference between the study and control groups regarding mothers' previous history of stillbirth. Regarding previous neonatal death, a significantly higher percentage of mothers in the study group reported a history of neonatal death compared to mothers in the control group (p-value < 0.01) (Table 4).

The incidence of preterm birth (14.3%) was significantly higher among IDM compared to non-diabetic mothers (5.1%), nearly three times higher (p-value < 0.05). (Table 5).

The rate of macrosomia among IDMs was significantly higher than that among infants of non-diabetic mothers, at 41.6% compared to 5.8%, respectively (p-value < 0.05). The rate of macrosomia among IDM was seven times that of infants of non-diabetic mothers. (Table 6)

Table 4: Distribution of the study and control groups according to mother's bad obstetric history.

Variable	**Study group**		**Control group**	
	No.	%	No.	%
Parity				
Primiparous	11	14.2	22	16
2-4	35	45.5	66	48.2
>5	31	40.3	49	35.8
p.value =0.801				
History of abortion				
Non	43	55.8	100	73
One abortion	24	31.2	29	21.2
Two or more	10	13	8	5.8
p. value=0.028				
History of still birth				
Yes	5	6.5	6	4.4
No	72	93.5	131	95.6
P. value =0.53				
History of neonatal death				
Yes	18	23.4	10	7.3
No	59	76.6	127	92.7
p.value =0.001				
Total	77	100	137	100

Table 5: Distribution of the study and control groups according to gestational age at delivery.

Gestational age	Study group		Control group	
	No.	%	No	%
Preterm	11	14.3	7	5.1
Term	66	85.7	130	94.9
Total	77	100	137	100
p-value = 0.02				

Table 6: Distribution of the study and control groups according to birth weight.

Birth Weight (g)	Study group		Control group	
	No.	%	No.	%
< 2500	4	5.2	6	4.4
2500-3999	41	53.2	123	89.8
4000>	32	41.6	8	5.8
Total	77	100	137	100
p-value = 0.0001				

The rate of respiratory distress among IDM (18.57%) was markedly higher than that among infants of non-diabetic mothers, and this difference was statistically significant (p-value < 0.05). However, the difference between the two groups in the rate of transient tachypnea of the newborn (TTN) did not reach the statistical level of significance (p-value > 0.05).

The risk of hyperbilirubinemia among IDM (14.9%) was higher than that for infants of non-diabetic mothers, and the association between maternal diabetes and the rate of neonatal hyperbilirubinemia was statistically significant (p-value < 0.05). The most common congenital anomalies identified in this study included congenital hip dislocation, congenital heart disease, Down syndrome, and ambiguous genitalia. The difference between the study and control groups in their rates of congenital malformations (9.3%) was statistically significant (p-value < 0.05) (Table 7).

Table 7: Neonatal complications of the study and control groups.

Complication	Study Group (N = 77)		Control group (N = 137)		RR	p-value
	No.	%	No.	%		
RDS	10	13	1	0.7	18.57	0.000
TTN	9	11.7	9	6.6	1.8	0.195
Hyperbilirubinemia	8	10.4	1	0.7	14.9	0.001
Congenital Malformation	5	6.5	1	0.7	9.3	0.024

The incidence of hypoglycemia at different levels of severity was diagnosed in 31 (40.3%) of IDM. Mild hypocalcemia was diagnosed in 5 (9.3%) of 54 infants, and 8 (12.5%) of IDM were polycythemia. (Table 8)

Table 8: Hypoglycemia, hypocalcemia, and polycythemias.

Variable	Number	%
Hypoglycemia	31	40.3
Hypocalcemia	5	9.26
Polycythemia	8	12.5

DISCUSSION

Gestational diabetes mellitus (GDM) represented 61% of diabetic mothers in the study group, while the remaining 39% had pregestational diabetes mellitus (PGD) (type 2 was 31.2% and type 1 was 7.8%). This pattern is consistent with findings from several other studies.[3,4,12,13] The study found a significantly high percentage of diabetic mothers had a positive history of previous abortion (31.2% had one abortion), a result similar to studies reported in Belgrade and Serbia.[12,14] Additionally, the previous history of at least two abortions (13%) among diabetic mothers in this study was comparable to that reported in Erbil.[3] The high risk of abortion associated with maternal diabetes is primarily attributed to poor maternal metabolic control during early gestation and congenital anomalies.[14-16]

Conversely, the history of previous stillbirth was not significantly different from that of the control group and was lower than that reported in other studies.[3,14] The high risk of stillbirth among diabetic pregnant women is mainly due to fetal hypoxemia and congenital abnormalities.[17, 18]

This study revealed a high incidence of preterm delivery (14.3%) compared to the control group (5.1%). Similar results were reported in Nigeria[12] (14.9%) and in Iran[14] (18.5% among GDM and 10.9% among PGD). The incidence of preterm birth was lower in Peshawar (Pakistan)[4] at 11.9% and in Chittagong City (Bangladesh)[13] at 7.6%. In a study conducted in Erbil[3], the incidence of preterm birth among IDM was much higher at 27.9%. The incidence of preterm birth can be

attributed to the high incidence of genitourinary infections during late pregnancy, polyhydramnios, fetal distress, macrosomia, and PE.[15, 19]

Macrosomia is considered the hallmark of diabetic pregnancy, documented in 41.6% of cases, which is significantly higher than in the control group, while the incidence of low birth weight was 5.2%. These results were much lower than those reported in a study in Nigeria, where 61.7% of IDM were macrosomic.[12] Similarly, the incidence of macrosomia was slightly lower than that documented in a study in Islamabad, where it affected 45% of cases.[20] Conversely, the results of the present study were much higher than those reported in the Chittagong study, where the incidence of macrosomia was (21%).[13]

In the current study, the occurrence of respiratory distress syndrome (RDS) in IDM was much higher than in the control group (13% vs. 0.7%). Most cases were mild (e.g., mild respiratory distress) and were discharged after a few days, although two of them died due to prematurity. The incidence of RDS among IDM in the present study (13%) appears to be higher than that reported in other studies conducted in Nigeria[12] (6.3%) and Ohio state (6%).[21] This finding can be attributed to poor glycemic control.[5]

Regarding transient tachypnea of the newborn (TTN), IDM developed 11.7%, which was double the incidence among the control group (6.6%); all responded well to oxygen therapy. The risk of TTN was nearly similar to that reported in Peshawar (11.9%)[4], higher than that reported in the Ohio State study (7%),[16] and much lower than in Nigeria (62.5%)[12]. In this study, a high percentage of IDM was treated for hyperbilirubinemia (10.4%) compared with 0.7% of the control group. In other studies, such as those in Al-Khobar (Saudi Arabia)[22], Turkey[23], Peshawar[4], Islamabad[20], Nigeria[12], and Ohio[21], the incidence of hyperbilirubinemia was higher (18%, 38%, 19%, 30%, 57%, and 25% respectively).

In this study, 12.5% of IDM were diagnosed with polycythemia. This result was close to that reported in Nigeria (10.6%)[12], Peshawar (12%),[4] and Al-Khobar (13%)[22] but higher than in Ohio (5%)[21] and lower than in Chittagong (19%).[13] The occurrence of polycythemia in IDM is due to increased erythropoiesis secondary to hyperinsulinism, which may affect fetal oxygen availability.[24,25] The incidence of congenital malformations among IDMs was 6.5% (including congenital hip dislocation, congenital heart disease, Down syndrome, and ambiguous genitalia). This rate is comparable to those reported in Ohio and Chittagong studies (5% and 5.7%, respectively).[13,21] Higher rates were reported in Eastern Saudi Arabia,[26] Erbil,[6] Iran,[14] and Islamabad,[20] where the incidence rates of congenital malformations were (7.8%, 9.2%, 11%, and 25%, respectively. The high risk of congenital malformations associated with maternal diabetes during pregnancy is mainly due to the effect of maternal hyperglycemia on the developing embryo during the early weeks of conception.

Among the various metabolic disorders affecting IDM, hypoglycemia was found to be the most common, affecting 40.3% of infants born to diabetic mothers. The incidence of hypoglycemia in the present study was similar to that reported in studies conducted in Al-Qatif (38.6%)[9] and Islamabad (35%)[20], while it was higher than the estimated incidence in other studies conducted in Iran,[14] Peshawar,[4] Chittagong,[13] and Ohio State[21] (20%, 23.8%, 23%, and 27%, respectively)[12,23] and lower than those in Nigeria and Turkey (63.8% and 52% respectively).[12,23] The high incidence of hypoglycemia in the present study may reflect poor glycemic control in diabetic mothers, especially in late pregnancy and near labor. Hypocalcemia was documented in 9.3% of IDM; other studies in Turkey[23], Islamabad,[20] Peshawar,[4] Nigeria[12], and Chittagong[13] reported higher incidence rates (14%, 15%, 16.6%, 23%, and 19%, respectively). While in Ohio State[21], the incidence was only 4%. The relatively low incidence rate of hypocalcemia found in the present study is partly due to the estimation of serum calcium levels within the first 24 hours after delivery.

In the present study, the history of neonatal death (due to prematurity and congenital heart disease) was higher in diabetic mothers (23.4%) than in the control group (7.3%). High neonatal death rates among IDM are primarily attributed to the high incidence of congenital malformations.[27] Other predominant causes of mortality include birth trauma, respiratory distress syndrome, extreme prematurity, growth restriction, and intrapartum asphyxia.[13,28]

CONCLUSIONS

A high frequency of complications was observed among the IDMs. These infants should be delivered in hospitals where special neonatal care facilities for managing high-risk babies. Moreover, screening for GDM should be performed in all pregnant women. Most importantly, strict glycemic control in mothers, proper antenatal care, and strict monitoring of infants are essential to prevent morbidity and mortality in infants of diabetic mothers.

Recommendations

The following are the recommendations derived from the study findings:

1. Implement routine antenatal care (ANC) screening of all pregnant women through glucose testing early in pregnancy to detect pregestational diabetes and at 24–28 weeks of gestation to detect gestational diabetic mothers.
2. Develop counseling programs for all diabetic mothers before conception.
3. Promote education for mothers during ANC or through special educational programs via media, TV, and meetings, emphasizing the importance of family planning to improve neonatal outcomes.
4. Establish cooperation between obstetricians and neonatologists, which is crucial in planning for neonatal resuscitation and care.
5. Given the high incidence of hypoglycemia among IDM, early breastfeeding should be encouraged to prevent unnecessary admissions to the NICU.

REFERENCES

1. Powers AC. Diabetes mellitus. In: Fauci AS, Kasper DL, Longo DL, Braunwald E, Hauser, Jameson JL et al., editors. Harrison's principles of internal medicine. 17th ed. New York: McGraw-Hill Medical; 2008. p. 2275-2305.
2. Tower, CL. Antenatal complications; maternal. In; Luesley DM, Baker PHN, editors. Obstetrics and Gynecology: An evidence – based text for MRCOG. 2nd ed. London: Hodder Arnold; 2010: p. 49-59.
3. Akhlghi F, Hamedi AB. Comparison of maternal and fetal/neonatal complications in gestational and pre-gestational diabetes mellitus. Acta Medica Iranica.; 2005;43(4):263-267.
4. Anderson GM, Hux JE, Sykora K, Razzaq A, Feig DS. Trends in deliveries, prenatal care, and obstetrical complications in women with pregestational diabetes: a population- based study in Ontario, Canada 1996-2001. Diabetes Care. 2006;29:232-235.
5. Alaf SK. Diabetes during labor: types, mode of delivery and fetal outcome in Erbil maternity teaching hospital. Journal of Zankoy Sulaimani. 2008;11(1):118-125.
6. Baker PHN, Kenny LC, editors. Obstetric by ten teachers. 19th ed. London: Hodder Arnold; 2011;4,270.
7. Gomella TL, Eyal FG, Zenk KE. Neonatal: management, procedures, on-call problems, diseases, and drugs. 5th ed. New York: McGraw-Hill Companies; 2004. p. 557-565.
8. Gardosi J. Normal fetal growth. In: Edmonds DK, editor. Dewhurst's textbook of obstetrics and gynecology. 7th ed. Oxford UK: Blackwell Pub.; 2007. p. 28-34.
9. Stoll BJ. The fetus and the neonatal infant. In: Behrman RE, Kliegman RM, Jenson HB, editors. Nelson's textbook of pediatrics. 18th ed. Philadelphia: WB Saunders Co.; 2007. p. 782-786.
10. Thilo EH, Rosenberg AA. The newborn infant. In: Hay WW, Levin MJ, Sondheimer JM, Deterding RR, editors. Current Diagnosis & Treatment in Pediatrics. 19th ed. New York: McGraw-Hill Companies; 2009. p. 1-60.
11. Gowen CW. Fetal and neonatal medicine. In: Kliegman RM, Jenson HB, Behrman RE, Marcdante KJ, editors. Nelson Essentials of Pediatrics. 6th ed. Philadelphia: WB Saunders Co.; 2011. p. 213-265.
12. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010;27(suppl):5-10.
13. Dailey TL, Coustan DR. Diabetes in pregnancy. Neo Reviews 2010;11(11): 619-626.
14. Cetkovic A, Durovic M. Neonatal outcome in pregnancies complicated with pregestational diabetes mellitus. Vojnosanti Pregl.2007; 64(4):231-234.
15. Metzger BE. International Association of Diabetes and Pregnancies Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. Diabetes Care. 2010;33(3):676-682.
16. Schmidt MI, Duncan BB, Reichelt AJ. Gestational diabetes mellitus diagnosed with a 2-h 75-g oral glucose tolerance test and adverse pregnancy outcomes. Diabetes Care. 2001;24(7):1151-1155.
17. Hussein SG, Ajeel NAH. Screening for gestational diabetes by 50 grams glucose challenge test. The Medical Journal of the University of Basrah. 2008;26(1):42-48.
18. Acolet D, Carney L, Dornhorst A, Fraser R, Gadsby R, Hawdon J et al. Diabetes in pregnancy: management of diabetes and its complications from pre-conception to the postnatal period. NICE Clinical Guideline 63. 2008. Available from www.nice.org.uk/CG63T
19. Opara PI, Jaja T, Onubogu UC. Morbidity and mortality among infants of diabetic mothers admitted into a special care baby unit in Port Harcourt, Nigeria. Italian Journal of Pediatrics. 2010;36:77.
20. Lindsay RS. Gestational diabetes: causes and consequences. Br J Diabetes Vasc Dis 2009;9:27-31.
21. Nold JL, Georgieff MK. Infants of diabetic mothers. Pediatr Clin N Am. 2004;51:619-637.
22. Bowman E, Fraser. Infants of the diabetic mother. Neonatal Handbook; 2011.
23. Dornhous A, Williamson C. Diabetes and endocrine disease in pregnancy. In: Edmonds DK, editor. Dewhurst's textbook of obstetrics and gynecology. 7th ed. Oxford, UK: Blackwell Pub.;2007. p. 246-260.

24. Murthy EK, Renar IP, Metelko Z. Diabetes and pregnancy. Diabetologia Croatica. 2012;31(3):131-146.
25. Rosenberg TJ, Garbers S, Lipkind H, Chiasson MA. Maternal obesity and diabetes as risk factors for adverse pregnancy Outcomes: differences among four racial/ethnic groups. Am J Public Health. 2005;95(9):1545-1551.
26. Landy HJ. The impact of maternal illness on the neonate. In: MacDonald MG, Seshia MMK, Mullett MD, editors. Avery's neonatology. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2005. p. 207-209.
27. Ogata ES. Problems of the infant of the diabetic mother. Neo Reviews. 2010;11(11):627-631.
28. Assche FAV, Holemans K, Aerts L. Long-term consequences for offspring of diabetes during pregnancy. British Medical Bulletin. Oxford Journal. 2012;60(1):173-182