Iraqi JMS

Published by Al-Nahrain College of Medicine
P-ISSN 1681-6579
E-ISSN 2224-4719
Email: iraqijms@colmed-alnahrain.edu.iq
http://www.colmed-alnahrain.edu.iq
http://www.iraqijms.net
Iraqi JMS 2017; Vol. 15(3)

The Neonatal Outcome in Infant Born to Gestational and Pre-Gestational Diabetic Mothers

Duha E. Kadhum[1] *MBChB*, **Sawsan S. Abbas**[2] *CABP, DCH*, **Deia K. Khalaf**[2] *FICMS*

[1]Al-Imamein Al-Kadhimein Medical City, Baghdad, Iraq [2]Dept. of Pediatrics, College of Medicine, Al-Nahrain University, Baghdad, Iraq

Abstract

Background Diabetes is the 2nd commonest medical complication of pregnancy after hypertension. Infants of diabetic mothers are those infants born to a mother who suffers from diabetes mellitus, but the term refers especially to infants born to a mother who has persistently elevated blood sugar during pregnancy.

Objective To study the complications in infants of diabetic mothers and the difference in the complications between infants of gestational and pre-gestational diabetic mothers.

Methods A cross sectional observational study carried out on (100) neonates of diabetic mothers that delivered in Al-Imamein Al-Kadhimein Medical City; the data was collected between 1st of September 2015 to 1st of December 2015. Maternal history was taken about type of diabetes and babies were divided into 2 groups; 1st group was infants of pregestational diabetic mothers and 2nd group was infants of gestational diabetic mothers. Thorough physical examination of these infants at birth at the neonatal care unit was done. Laboratory investigations included blood sugar, serum calcium, hematocrit, total serum bilirubin and echocardiograph was done in all babies but chest x-ray, abdominal ultrasound, brain ultrasound and electrocardiogram were done whenever indicated.

Results The 1st group (36 cases) 36% of infants was product of mothers having pregestational diabetes and the 2nd group (64 cases) 64% infants of gestational diabetic mothers. Mothers were delivered by cesarean section in 69%. Mothers were primigravida in 31%. Female 59% to male ratio 1.4:1. Hypoglycemia at birth was documented in 39% of cases, was nearly equal in both groups (20%, 19%) respectively. Hypocalcemia in 18%, was more in infants of pregestational diabetic mothers (11% and 7%) respectively. Respiratory complications were the most prominent complications 41 % nearly equal in both groups (22% and 19%) respectively. Macrosomia seen in 23%, more in infants of gestational diabetic mothers (7% and 16%) respectively. Forty % of infants of both group have been discharged in the first 24 hours.

Conclusion The respiratory complications were the most prominent followed by hypoglycemia that occurred mainly to infants of pregestational diabetic mothers. There are statistical differences in infants of pregestational diabetic mothers regarding hypoglycemia, hypocalcemia and respiratory complications. Macrosomia is more in infants of gestational diabetic mothers.

Keywords Neonate, infants, gestational, pregestational diabetes.

Citation Kadhum DE, Abbas SS, Khalaf DK. The neonatal outcome in infant born to gestational and pre-gestational diabetic mothers. Iraqi JMS. 2017; Vol. 15(3): 268-274. doi: 10.22578/IJMS.15.3.8

List of abbreviation: CNS: Central nervous system, GDM = Gestational diabetic mothers, GIT = Gastro intestinal tract, IGD = Infants of gestational diabetes IGD, IPGD = Infants of pregestational diabetes, PGDM = Pregestational diabetic mothers

Introduction

Infants of diabetic mothers are those infants born to a mother who suffer from diabetes mellitus. But the term refers especially to

infants born to a mother who has persistently elevated blood sugar during pregnancy [1].

Diabetes is the second commonest medical complication of pregnancy after hypertension [2]. Fetal and neonatal mortality rates were as high as 65% before the development of specialized maternal, fetal, and neonatal care. Since the discovery of insulin, infants of diabetic mothers have experienced an almost 30-fold decrease in mortality and morbidity [3].

There are two types of diabetes that occur in pregnancy: Gestational diabetes refers to a mother who does not have diabetes before becoming pregnant but develops a resistance to insulin because of the hormones of pregnancy. Pregestational diabetes describes women who already have diabetes before they become pregnant [4].

This study aimed to study the complications in infants of diabetic mothers and the difference in the complications between infants of gestational and pre-gestational diabetic mothers.

Methods

A cross sectional observational study was carried out on (100) neonates of diabetic mothers that delivered in Al-Imamein Al-Kadhimein Medical City; the data was collected between 1st of September 2015 to 1st December 2015.

Maternal history was taken about types of diabetes either gestational or pregestational as well as type of treatment used to control blood sugar, parity and mode of delivery. According to maternal history of diabetes, the neonates were divided into two groups; 1st group was infants of pregestational diabetic mothers and the 2nd group was infants of gestational diabetic mothers.

Thorough physical examination of these babies was done including: assessment of gestational age by Ballard Maturational Assessment then classified into term (gestational age 37-40 weeks), preterm (gestational age less than 37 weeks) [5], gender, weight, length, head circumference, systemic examination looking for congenital anomalies and assessment of respiratory distress. Babies with weight of $\geq$ 4000 gm were labeled as macrocosmic and with birth weight < 2500 gm as low birth weight (LBW) [6]. The head circumference from 33 to 36 cm were considered normal range [7].

The laboratory investigations included serial blood sugars initially at birth and half hourly in hypoglycemic neonates; done by a heel prick after sterilization with alcohol swab and measuring random blood sugar by glucometer (Accu-Check Go (ROCHE) [8]. Hypoglycemia was labeled when the blood sugar was less than 25 mg/dl in the 1st 24 hours [9]. Serum calcium was done within the 1st 24 hours of birth, which was done by non-tourniquet venous sample. Hypocalcemia was considered when total ionized serum calcium was less than 8 mg/dl (2 mmol/dl) [10]. The hematocrit was done by using heparinized micro capillary tube (0.75 ml) centrifuged at speed of (10,000-15,000) round per minute, plasma separate packed cell volume was measured to give the hematocrit level, polycythemia considered when hematocrit more than 65% [11]. Total serum bilirubin was done by spectrophotometer; physiological jaundice was considered when the total serum bilirubin was 1-3 mg/dl and the rate of rise was less than 5 mg/dl in 24 hr [12]. Echocardiography was done to all neonates. Chest X-ray, abdominal ultrasound, brain ultrasound and CT scan of brain as needed.

Simple statistical analysis was done including percentage estimations and tabulation using Microsoft excel program. Chi-square (X2) test was done using SPSS version 21. P value was calculated, statistically significant if its <0.05 and highly significant if < 0.001 [13].

Results

Of one hundred neonates, there were 64% with gestational diabetes mellitus (GDMs) and 36% with pre-gestational diabetes mellitus (PGDMs). The mean of maternal age for both groups was (28±5) years. Types of treatment for PGDMs and GDMs were on diet, insulin and without treatment. The results are highly significant as P. value < 0.001 as shown in table 1.

Table 1. Distribution of mothers according to type of treatment (pregestational or gestational)

Type of treatment	PGDM No. = 36 No. (%)	GDM No. = 64 No. (%)	Total (%)	P .value
Diet	19 (52.78)	22 (34.38)	41	
Insulin	15 (41.67)	15 (23.43)	30	0.0005*
No treatment	2 (5.55)	27 (42.19)	29	

*Statistically highly significant

There were 31% primigravida {10 (27.78%) with PGDM and 21 (32.81%) with GDM}, while 69% were multigravida {26 (72.22%) with PGDM and 43 (67.19%) with GDM} as shown in table 2.

The mode of delivery was by Cesarean section (C/S) in 69% and 31% by normal vaginal delivery (NVD). Nine cases (25.0%) of pregestational diabetic mothers (PGDMs) delivered by NVD, 22 (34.37%) of gestational diabetic mothers (GDMs) delivered by NVD, 27 (75.0%) of PGDMs delivered by C/S and 42 (65.63%) of GDMs delivered by C/S, none with assisted delivery as shown in table 2.

Table 2. Distribution of mothers according to parity and mode of delivery (pregestational or gestational)

Parameter		PGDM No.=36 No. (%)	GDM No.=64 No. (%)	Total %	P. value
Parity	Primigravida	10 (27.78)	21 (32.81)	31	0.6577
	Multigravida	26 (72.22)	43 (67.19)	69	
Mode of delivery	NVD	9 (25.0)	22 (34.37)	31	0.3747
	C/S	27 (75.0)	42 (65.63)	69	
	Assisted delivery	0	0	0	

There were 59% females and 41% males with female to male ratio 1:4:1 as shown in table 3. Preterm babies were 51% and 49% term babies as shown in table 3. The mean weight was (3.2±0.75) Kg with a range of (1.2-4.8) Kg, low birth weight found in 24% and macrosomia found in 23% as shown in table 3.

Table 3. Infants variables

Infants variables		IPGD No. = 36 No. (%)	IGD No. = 64 No. (%)	Total %	P. value
Gender	Female	21 (58.33)	38 (59.38)	59	1.000
	Male	15 (41.67)	26 (40.62)	41	
Gestational age	Preterm	23 (63.89)	28 (43.75)	51	0.0629
	Term	13 (36.11)	36 (56.25)	49	
Birth weight (kg)	< 2.5	7 (19.44)	17 (26.56)	24	0.4738
	2.5-3.9	22 (61.11)	31(48.44)	53	
	≥ 4.0	7 (19.44)	16 (25.0)	23	

IPGD = Infants of pre-gestational diabetes, IGD = Infants of gestational diabetes

Hypoglycemia was found in 39%, as it was observed in (14 IPGDMs and 13 IGDMs); 70% as asymptomatic neonates and 30% presented with (jitteriness, seizure, tachypnea and irritability). The hypoglycemia improves from the 1st day to the 2nd day for all babies. Hypocalcaemia presented as asymptomatic in 50% and the other with symptoms just like hypoglycemia. Polycythemia presented in 7%; only 3 patients need partial blood exchange transfusion whom IPGDMs. The results for hypoglycemia and hypocalcaemia are statistically significant as P. value < 0.05. As shown in table 4.

Table 4. Distribution of metabolic abnormalities in infants (pregestational or gestational)

Metabolic abnormalities		IPGD No. = 36 No. (%)	IGD No. = 64 No. (%)	Total %	P. value
Hypoglycemia	Positive	20 (55.56)	19 (29.69)	39	0.0182**
	Negative	16 (44.44)	45 (70.31)	61	
Hypocalcemia	Positive	11 (30.56)	7 (10.94)	18	0.0277**
	Negative	25 (69.44)	57 (89.06)	82	
Polycythemia	Positive	4 (11.11)	3 (4.69)	7	0.2479
	Negative	32 (88.89)	61 (95.31)	93	

** Statistically significant

The respiratory complications occurred in 41% of infants diagnosed by clinical feature and radiological findings in form of hyaline membrane disease (RDS) and transient tachypnea of the newborn (TTN). In relation to cardiac complications, 6% of infants diagnosed as congenital heart disease which was documented by echocardiograph as 1% atrial septal defect (ASD), 3% ventricular septal defect (VSD), 2% patent ductus arteriosus (PDA). One newborn (IPGDM) had diaphragmatic hernia. All babies had occipitofrontal circumference (OFC) within normal ranges except for two infants with OFC more than 40 cm diagnosed to have hydrocephalus by brain ultrasound. The differences in respiratory complications between the 2 groups were highly significant with a P-value < 0.001 as shown in table 5.

Concerning discharge from the hospital, 10 cases (27.77%), 15 cases (41.67%), 11 cases (30.56%) discharged in the 1st 24 hours, 2nd-5th day, more than 1 week respectively for IPGDMs while 30 cases (46.88%) of infants of gestational diabetes were discharged in the first 24 hr as shown in table 6.

Discussion

The study included 100 mothers, 36% of whom had PGDM and 64% GDM, which is close to the study in Iran by Tabib et al. in 2013, which found that 40% PGDM and 60% GDM [14].

Type of treatment of diabetes mellitus was diet control in 41% while insulin used in 30%, 29% without treatment and no patients on oral hypoglycemic agent; this differ from a study done in Switzerland by Ullmo et al. in 2007, which showed that 81% of mothers on insulin treatment while 19% were on diet control [15]; also differs from a study done in Islamabad by Alam et al. in 2006 who found that 47.5% on insulin 12.5% on diet and 40% without any treatment [16]. High percentage of mothers in the current study were on no treatment this reflects poor compliance of therapy in our patients.

Table 5. Distribution of systemic complications of infants (pregestational or gestational)

Systemic complications		IPGD No. = 36 No. (%)	IGD No. = 64 No. (%)	Total %	P .value
Respiratory complications	RDS	22 (61.11)	13 (20.31)	35	0.0001*
	TTN	0 (0)	6 (9.38)	6	
	None	14 (38.89)	45 (70.31)	59	
Cardiac complications	ASD	1 (2.78)	0 (0)	1	0.0537
	PDA	1 (2.78)	1 (1.56)	2	
	VSD	3 (8.33)	0 (0)	3	
	None	31 (86.11)	63 (98.44)	94	
GIT complications	Diaphragmatic hernia	1 (2.78)	0 (0)	1	0.3600
	None	35 (97.22)	64 (100)	99	
CNS complications	Hydrocephalus	2 (5.56)	0(0)	2	0.0640
	None	34 (94.44)	64(100)	98	
Birth injury	None	0 (0)	0 (0)	0	0
Musculoskeletal anomalies	Sacral agenesis	0 (0)	0 (0)	0	0

* Statistically significant

Table 6. Distribution of day of discharge in infants (pregestational or gestational)

Day of discharge	IPGD No. = 36 No. (%)	IGD No. = 64 No. (%)	P. value
1st	10 (27.77)	30 (46.88)	0.1242
2nd–5th	15 (41.67)	23 (35.94)	
More than 1 week	11 (30.56)	11 (17.18)	

Female to male ratio was 1.4:1, which differs from a study done in Pakistan by Shirazi et al. in 2010 in which, female to male 1:1.3 (17). This is due to small sample and short period of time in the current study.

The mode of delivery was by C/S in 69, which is close to a study from Switzerland done by Ullmo et al. in 2007, which found that 61% of mothers were delivered by C/S (15). This high rate of C/S deliveries in this study is due to bad obstetrical history, failure of induction, macrosomia and miscalculation. Both groups with the same risk for having C/S delivery.

There were 51% preterm babies and 49% term infants. This is higher than a study done by Nwankwo et al. in Nigeria in 2013, which showed that 41% preterm labor [18], also higher than a study from Pakistan done by Shirazi et al. in 2010, preterm in 19% while full term 81% [17]. This high rate of preterm babies is due to the fact that diabetes in pregnancy increases the risk of preterm labor because of polyhydramnios, which cause sudden rapture of membrane [19]. High percentage of preterm in our study reflects poor glycemic control in the mothers.

The mean of birth weight was (3.2±0.75) Kg, which is less than the study in Nigeria by Opara et al. in 2010, which found that the mean weight was (4.14 ±0.838) Kg [20]. This difference is due to the fact that we have more preterm

labor, small mass of the study group and poor compliance of the mothers.

Macrosomia seen in 23%, which is less than the study in Saudi Arabia by Yaseen et al. in 1999 in which, 30% were macrosomic [21], but higher than the result in a study done in Pakistan by Shirazi et al. in 2010 as macrosomia was 15% [17]. Also, higher than a study done by Nwankwo et al. in Nigeria in 2013, (5.1%) [18]. Macrosomia is more in IGDMs, which is the same as a study done in Ohio by Cordero et al in 2015 [22].

Multigravida mother were 69%, this is less than the study done by Nwankwo et al. in Nigeria in 2013 in which, multigravida account for 74% [18]. This is due to increased risk of gestational diabetes with increase maternal age.

Hypoglycemia 39%, which is close to a study done in Islamabad by Alam et al. in 2006 (35%) [16] and close to a study done in Ohio by Cordero et al. in 2015 (36%) was more in IPGDMs [22].

Hypocalcemia 18%, which is close to a study done in Islamabad by Alam et al. in 2006 15% [16], more common in IPGDMs in a study done by Shirazi et al. in 2010 [17].

Polycythemia 7%; is close to the study of Shirazi et al. in 2010 (8%) [17].

Cardiac anomalies 6%, this result is close to a study in Iran by Tabib et al. in 2013 as (8.8%) of infants with congenital heart disease being more in PGD [14]. Also, it is close to the result of a study by Ullmo et al in 2007 (5%) [15].

Respiratory complications 41% and more common in IPGDMs, the results are more adherent to by Ullmo et al. study in 2007 (36%) [15]. Also, is close to a study in Nigeria by Opara et al. in 2010 in which, respiratory complications were noted in 34% [20].

For congenital anomalies; anomalies related to gastrointestinal system, only one case 1%, which is similar to Shirazi et al. study in Pakistan in 2010, which is also 1% of duodenal atresia and 1% of anorectal atresia [17].

Central nervous system complications 2%, which was near the result in Shirazi et al. study done in Pakistan in 2010, which was 1% [17].

The mean of infants stay in hospital was (4.61 ±3.35) days, which is less than in Opara et al. study in Nigeria in 2010 in which, the mean of duration of admission was (6.97±2.63 days) [20]. The time that needed to stay in hospital is less due to the fact that we have more deliveries at the same period, as we have 468 mothers were delivered at the same time and more preterm babies who need more time to recover from complications as hypoglycemia and polycythemia. Infants of diabetic mothers are at risk of deaths.

This study concluded that the respiratory complications are the most prominent that we faced in the neonatal care unit and followed by hypoglycemia that occur mainly in infants of pregestational diabetic mothers. There are statistical differences in infants of pregestational diabetic mothers regarding hypoglycemia, hypocalcemia and respiratory complications. Macrosomia is more in infants of gestational diabetic mothers.

Acknowledgments

To the staff in the Intensive Care Units and to the mothers of the babies included in the study.

Author contributions:

All authors contributed to this manuscript. They coordinated study recruitment, implementation and progress of this study and helped with data interpretation and manuscript organization and editing.

Conflict of interest

The authors have no conflict of interest.

Funding

Self-funding.

References

1. Waldemar AC, The high-risk infant. In: Kleigman RM, Stanton BF, Schor NF (eds). Nelson Textbook of Pediatrics. 20th ed. Philadelphia: Elsevier, WB Saunders company; 2016. p. 818- 20.
2. Baker PN, Lees C, Arnold E. Endocrine disorders. In: Baker PN, Monga A (eds). Obstetrics by Ten Teachers. 18th ed. UK: Hoddereducation; 2006. p. 186.

3. Cornblath M, Hawdon JM, Williams AF, et al. Controversies regarding definition of neonatal hypoglycemia: suggested operational thresholds. Pediatrics. 2000; 105(5): 1141-5.
4. Kaneshiro NK, Zieve D. Infant of diabetic mother. Health Encyclopedia, Agency for Health Care Administration, AHCA Network of Websites 12/4/2013. URL: http://www.floridahealthfinder.gov/healthencyclopedia/Health%20Illustrated%20Encyclopedia/1/001597.aspx.
5. Waldemar AC, Ambalavanan N. Fetal growth and maturity. In: Kleigman RM, Stanton BF, Schor NF (eds). Nelson Textbook of Pediatrics. 20th ed. Philadelphia: Elsevier, WB Saunders company; 2016. p. 806.
6. Carlo WA. The high-risk infant. In: Kliegman RM, Stanton BF, Gem ST, et al (eds). Nelson Textbook of Pediatrics. 19th ed. Philadelphia: Elsevier, WB Saunders company; 2011. p. 552-3.
7. Healthcare staff. Physical growth in newborns. Health Information & Tools. (20/2/2016) https://myhealth.alberta.ca/Health/Pages/conditions.aspx?hwid=te6295.
8. Fernandez BA, Perez IC. Neonatal hypoglcemia – current concepts. In: Rigobelo EC. Hypoglicemia – causes and occurrences. Croatia: Intechweb.Org; 2011. p. 85-102.
9. Mimouni FB, Mimouni G, Bental YA. Neonatal management of the infant of diabetic mother. Pediat Therapeut 2013, 4(1): 186. doi: 10.4172/2161-0665.1000186.
10. Malhotra Y, Pediatric hypocalcaemia, Medscape ,www.einstein.yu.edu/faculty/3790/deborah-campbell, Dec ,5,2016 ,(20/2/2017)
11. Lessaris KL. Polycythemia of the Newborn, Medscape. 2016. URL: http://emedicine.medscape.com/article/976319-overview. (Accessed at 20/2/2017).
12. Ambalavanan N, Waldemar AC. Jaundice and hyperbilirubinaemia in the newborn. In: Kleigman RM, Stanton BF, Schor NF (eds). Nelson Textbook of Pediatrics. 20th ed. Philadelphia: Elsevier, WB Saunders company; 2016. p. 873.
13. Danial W. Biostatistics, a foundation for analysis in the health sciences. Wiley and son Inc. 1999. p. 575-88.
14. Tabib A, Shirzad N, Sheikhbahaei S, et al. Cardiac malformations in fetuses of gestational and pre-gestational diabetic mothers. Iran J Pediatr. 2013; 23(6): 664-8.
15. Ullmo S, Vial Y, Di Bernardo S, et al. Pathologic ventricular hypertrophy in the offspring of diabetic mothers: a retrospective study. Eur Heart J. 2007; 28(11): 1319-25. doi: https://doi.org/10.1093/eurheartj/ehl416.
16. Alam M, Raza SJ, Sherali AR, et al. Neonatal complications in infants born to diabetic mothers. J Coll Physicians Surg Pak. 2006; 16(3): 212-5. doi: 3.2006/JCPSP.212215.
17. Shirazi H, Riaz S. Neonatal outcome of diabetic pregnancy. Ann Pak Inst Med Sci. 2010; 6(2): 107-12.
18. Nwankwo TO, Aniebue UU, Ezenkwele E, et al. Pregnancy outcome and factors affecting vaginal delivery of twins at University of Nigeria Teaching Hospital. Niger J Clin Pract. 2013; 16(4): 490-5. doi: 10.4103/1119-3077.116895.
19. Landon M, Duff P. Diabetes mellitus and other endocrine disease. In: Ling FW, Duff P (eds). Pocket guide to obstetrics and gynecology: principles for practice. McGraw Hill Publishers; 2002. p. 177- 89.
20. Opara PI, Jaja T, Onubogu UC. Morbidity and mortality amongst infants of diabetic mothers admitted into a special care baby unit in Port Harcourt, Nigeria. Ital J Pediatr. 2010; 36(1): 77. doi: 10.1186/1824-7288-36-77.
21. Yaseen HA, Al-Najashi SS, Adel AA, et al. Predictive factors and incidence of complications in apparently healthy full-term infants of diabetic mothers. J Family Community Med. 1999; 6(2): 37-42.
22. Cordero L, Paetow P, Landon MB, et al, Neonatal outcome of macrosomic infants of diabetic and non-diabetic mothers. J Neonatal Perinatal Med. 2015; 8(2): 105-12. doi: 10.3233/NPM-15814102.

Correspondence to Dr. Sawsan S. Abbas
E-mail: sawsansati@yahoo.com
saw-195@colmed-alnahrain.edu.iq
Received Dec. 12th 2016
Accepted Feb. 22nd 2017