RESEARCH ARTICLE

Assessment of neonatal glycaemic status and comorbidities in infants of diabetic mothers admitted to the neonatal care unit of Al-Ramadi Teaching Hospital for maternity and childhood, Iraq

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Abstract

Objective: To assess neonatal and maternal characteristics, glycaemic status and comorbidities in the neonates of diabetic mothers.

Method: The prospective, descriptive study was conducted from March 2021 to December 2021at the neonatal care unit of Al-Ramadi Teaching Hospital for Maternity and Childhood, Iraq, and comprised neonates of diabetic mothers admitted to the maternity ward or the neonatal care unit. Maternal and neonatal data was collected using a proforma. Blood glucose levels were measured using heel-stick sampling by glucometer in the first 1-3 hours of life. Mild neonatal hypoglycaemia was defined as glucose level ≤47mg/dL, and severe hypoglycaemia as ≤36mg/dL. Data was analysed using SPSS 24.

Results: Among the 70 mothers, aged between 18 to 44 years, gestational diabetes was the commonest type 52(74.3%), and, among the 70 neonates, 52(74.3%) developed mild hypoglycaemia, 12(17.1%) hypocalcaemia, 26(37.1%) congenital heart disease, 50(71.4%) respiratory distress syndrome, 24(34.3%) hyperbilirubinaemia, 2(2.9%) congenital anomalies, 6(8.6%) prematurity, and 4(5.7%) developed birth asphyxia. Prematurity, female gender and low birthweight were significantly associated with hypoglycaemia ($p<0.05$). No significant differences were detected in terms of neonatal complications between pregestational and gestational diabetic mothers ($p>0.05$).

Conclusions: Diabetic pregnancies were linked to a higher risk of neonatal complications.

Key Words: Diabetes, Gestational, Hypocalcemia, Asphyxia, Heel, Jaundice, Chronic Idiopathic, Respiratory Distress, Heart Defects, Congenital

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Introduction

Diabetes mellitus (DM) is one of the most frequent and serious metabolic illnesses that affect the health of both mothers and neonates[1], and about 4% of pregnancies are complicated by it[2]. Pregnant women with type 1 DM (T1DM), type 2 DM (T2DM) and gestational DM (GDM) are at an elevated risk of having an adverse pregnancy outcome. Glycaemic control is essential before and during pregnancy to improve the outcome[3].

Population-based studies have revealed that complications among infants of diabetic mothers (IDMs) are high. Respiratory distress syndrome (RDS), hypoglycaemia, congenital abnormalities and hyperbilirubinaemia were some of the documented complications, with congenital malformations being 2-10 times more common in IDMs than in the general population[4,5].

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The neonatal death rate (NDR) for IDMs is >5 times higher than for nondiabetic mothers' babies [6,] However, superior perinatal care for diabetic mothers and their newborns, and more importantly better conceptual glycaemic control, is likely to improve IDM outcomes and minimize the prevalence of reported complications and death [7].

Hypoglycaemia is reported to develop in 20-50% of IDMs and 15-25% of hypoglycaemic IDMs are born GDM mothers[8]. Hypoglycaemia is commonly observed in neonates who are small or large for gestational age, as well as in infants whose mothers had poor glycaemic control throughout pregnancy[9]. The nadir in IDM blood glucose levels primarily happens between 1-3 hours of life and can continue up to 72 hours or even a week[10].

Because neonatal hypoglycaemia is linked to a poor neurological outcome, blood glucose (BG) should be kept within normal range regardless of the presence or absence of aberrant clinical symptoms, and patients with hypoglycaemia should be diagnosed and treated quickly[11].

Despite its clinical importance, there remains debate on

the definition and screening of neonatal hypoglycaemia. Clinical recommendations show postpartum glucose screening of newborns at risk, with a threshold of 47mg/dL for mild hypoglycaemia and 36mg/dL for severe hypoglycaemia[12].

The vast majority of researchers indicate a 2-3-fold increase in malformations in infants of insulin-dependent diabetic mothers. There is the likelihood that proper medical management can eliminate the risk[13].

The current study was planned to IDMs.

Patients and Methods

The prospective, descriptive study was conducted from March 2021 to December 2021at Al-Ramadi Teaching Hospital for Maternity and Childhood, Al-Ramadi, Iraq. The sample comprised neonates admitted to the maternity ward or the neonatal care unit (NCU) born to mothers with pre-gestational DM regardless of type.

The sample size was calculated using the following formula: $n=Z2\ P(1-P)/d2$[14]. In the formula, n was the sample size, Z was the statistic corresponding to level of confidence (1.96), P was expected prevalence (0.045) it is obtained from a pilot study conducted by the researchers, and d was precision corresponding to the effect size (0.05). The sample was raised using random sampling technique through the envelope method after approval from the ethics review committee of the Mustansiriyah University, College of Medicine, Baghdad. Parents of the neonates furnished written informed consent.

Maternal and neonatal data was collected using a questionnaire. Maternal data included age, parity, type and duration of DM, treatment, degree of metabolic diabetic control after obtaining a median glycated haemoglobin (HbA1c) of three trimesters, if available (good control: HbA1c <7, and poor control: >7), antenatal care visits, and the mode of delivery (normal vaginal delivery or caesarean section [CS] delivery). Neonatal data included gender, gestational age, birthweight, cause of admission to NCU (hypoglycaemia, hyperbilirubinemia, respiratory distress syndrome [RDS], hyperbilirubinaemia, prematurity, birth asphyxia, sepsis, birth trauma, congenital heart diseases [CHD] or other congenital anomalies), and outcome (dead newborn or discharged well).

After birth, all neonates had been admitted for at least 24 hours, and birthweight and head circumference of all babies had been measured. A blood test for serum calcium and total serum bilirubin (TSB) had been done. BG levels were determined via heel-stick sample with a glucometer (OnCall Plus, Acon Laboratories Inc. United States) at 0, 1-3, 4, 6, 8, 12, 18 and 24 hours after birth before feeding. For the purpose of the current study, BG readings of the first 1-3 hours of life were used. The electrochemical glucose oxidase enzymatic test was used to detect glucose in capillary whole blood in a quantitative manner. It was a one-touch ultra blood glucose monitoring system with measurements ranging 20-600mg/dl (1.1-33.3 mmol/l).

Mild neonatal hypoglycaemia was defined as glucose level ≤47mg/dL, and severe hypoglycaemia as ≤36mg/dL[15]. Any hypoglycaemia noted was addressed with proper management. Additional breast milk or formula feeds were given as the first treatment, and in the event of persistent hypoglycaemia, intravenous (IV) glucose treatment was given to keep blood glucose levels >54mg/dL.

Any neonate born to normal mothers who were not diagnosed with diabetes mellitus of any type were excluded from the study.

Data was analysed using SPSS 24. Discrete variables were described as frequencies and percentages. Chi-square test and Fisher-Exact test were used, as appropriate. $P<0.05$ was considered significant.

Results

Among the 70 mothers, aged between 18 to 44 years, GDM was the commonest type 52(74.3%), 36(51.4%) were treated with insulin, 44(62.9%) reported good diabetes control during pregnancy, 54(77.1%) had a regular antenatal doctor follow-up, and 54(77.1%) had CS deliveries. Among the neonates, 36(51.4%) were boys,

Table-1: Maternal and neonatal characteristics.

Variable	No. (total: 70)	Percentage %
Type of maternal diabetes		
• Gestational	52	74.3%
• Type 1 DM	18	25.7%
• Type 2 DM	0	0.0%
Treatment of maternal diabetes		
• Diet	16	22.9%
• Oral hypoglycaemic	10	14.3%
• Diet & Oral hypoglycaemic	2	2.9%
• Insulin	36	51.4%
• Insulin & Oral hypoglycaemic	6	8.6%
Diabetes control		
• Poor	26	37.1%
• Good	44	62.9%
Follow-up		
• Irregular	16	22.9%

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• Regular	54	77.1%
Mode of Delivery		
• Caesarean	54	77.1%
• Normal vaginal	16	22.9%
Gender of baby		
• Male	36	51.4%
• Female	34	48.6%
Birth Weight		
• < 2.5 kg	4	5.7%
• 2.5-4 kg	50	71.4%
• > 4 kg	16	22.9%

DM: Diabetes mellitus.

Table-2: Maternal and neonatal characteristics with respect to the severity of hypoglycaemia.

	The severity of Hypoglycaemia of the neonate*				*p*
	Mild		Severe		value
	52	100.0%	18	100.0%	<0.001
Gestational Age					<0.001*
• Preterm	0	0.0%	8	44.4%	
• Term	52	100.0%	8	44.4%	
• Post-term	0	0.0%	2	11.1%	
Gender of baby					0.042
• Male	32	61.5%	4	22.2%	
• Female	20	38.5%	14	77.8%	
Birth Weight					0.045*
• < 2.5 kg	0	0.0%	4	22.2%	
• 2.5-4 kg	40	76.9%	10	55.6%	
• > 4 kg	12	23.1%	4	22.2%	
Type of maternal diabetes					0.077
• Gestational	38	73.1%	14	77.8%	
• Type 1DM	14	26.9%	4	22.2%	
• Type 2DM	0	0.0%	0	0.0%	
Treatment of maternal diabetes					0.606
• Diet	12	23.1%	4	22.2%	
• Oral hypoglycaemic	10	19.2%	0	0.0%	
• Diet & Oral hypoglycaemic	2	3.8%	0	0.0%	
• Insulin	24	46.2%	12	66.7%	
• Insulin & Oral hypoglycaemic	4	7.7%	2	11.1%	
Diabetes control					0.185
• Poor	16	30.8%	10	55.6%	
• Good	36	69.2%	8	44.4%	
Follow-up					0.074
• Irregular	8	15.4%	8	44.4%	
• Regular	44	84.6%	10	55.6%	

*Mild neonatal hypoglycaemia was defined as glucose level ≤47mg/dL and severe hypoglycaemia as ≤36mg/dL[14].
DM: Diabetes mellitus.

and 50(71.4%) had an average birthweight (Table 1).

Considering complications of IDMs, 52(74.3%) developed mild hypoglycaemia, 12(17.1%) hypocalcaemia, 26(37.1%) CHD, 50(71.4%) RDS, 24(34.3%) hyperbilirubinemia, 2(2.9%) congenital anomalies, 6(8.6%) prematurity, and 4(5.7%) developed birth asphyxia. Gestational age, gender and birthweight were significantly associated with the severity of neonatal hypoglycaemia (Table 2).

Table-3: Complications among neonates of pre-gestational and gestational diabetic mothers.

Complications	Maternal Diabetes						P*
	Total		Gestational		Pre-gestational		value
	N=70	100.0%	N=52	100.0%	N=18	100.0%	
Hypoglycaemia							0.781
• Severe	52	74.3%	38	73.1%	14	77.8%	
• Mild	18	25.7%	14	26.9%	4	22.2%	
Hypocalcaemia							0.714
• Yes	12	17.1%	12	23.1%	0	0.0%	
• No	58	82.9%	40	76.9%	18	100.0%	
Birth Trauma							0.418
• Yes	4	5.7%	2	3.8%	2	11.1%	
• No	66	94.3%	50	96.2%	16	88.9%	
CHD							0.185
• Yes	26	37.1%	16	30.8%	10	55.6%	
• No	44	62.9%	36	69.2%	8	44.4%	
RDS							0.221
• Yes	50	71.4%	40	76.9%	10	55.6%	
• No	20	28.6%	12	23.1%	8	44.4%	
Hyperbilirubinaemia							0.376
• Yes	24	34.3%	20	38.5%	4	22.2%	
• No	46	65.7%	32	61.5%	14	77.8%	
Congenital Anomalies*							0.551
• Yes	2	2.9%	2	3.8%	0	0.0%	
• No	68	97.1%	50	96.2%	18	100.0%	
Prematurity							0.752
• Yes	6	8.6%	4	7.7%	2	11.1%	
• No	64	91.4%	48	92.3%	16	88.9%	
Birth Asphyxia							0.392
• Yes	4	5.7%	4	7.7%	0	0.0%	
• No	66	94.3%	48	92.3%	18	100.0%	

*Congenital Anomalies were cleft lip and palate and undescended testis.
CHD: Congenital heart disease, RDS: Respiratory distress syndrome.

No significant differences were detected in terms of neonatal complications between pregestational and gestational diabetic mothers (Table 3).

Discussion

In the current study, GDM was the commonest type among the mothers, which is similar to an earlier study.[7,16,17]

CS was the common mode of delivery, similar to two studies[7,16].

Regarding complications in IDMs, hypoglycaemia was the commonest, with 74.3% having mild hypoglycaemia and 25.7% severe. One study18 reported the incidence of mild and severe hypoglycaemia to be 33.4% and 20.2%, respectively. The high incidence was despite the focus on

early and frequent feeding in babies at risk, including advising mothers before delivery about the necessity of starting feeding as soon as possible after birth, and then feeding frequently.

Hypocalcaemia as metabolic neonatal complication was noted in the current study. which was in line with several studies[7,16,19]. It has been proposed that diabetic mothers' hyperparathyroidism might reduce foetal parathyroid functionality, resulting in neonatal hypocalcaemia[20].

Traumatic injuries involved 2 cases of large cephalohematomas and 2 cases of Erb's palsy, and this may be attributed to the heavier birthweight of these babies. The incidence of macrosomia in the current study (22.9%) was lower than 26.7% reported by a study[7]. This was most likely due to the elective plan for delivery at 37-38 weeks of gestation. The current result was lower than the 61.7% reported by another study[16], and this may be explained by better glycaemic control of diabetic mothers since most authors showed that poor maternal glucose control was linked to macrosomia[16].

CHD was reported in one-third of the current patients, which was close to an earlier result [21] (32%), but higher than another's[22] (7.5%). The commonest cardiac anomaly was atrial septal defect (ASD), followed by patent ductus arteriosus (PDA) and ventricular septal defect (VSD), which was similar to one study[21].

IDMs suffered from RDS (71.4%), which can be explained by the functional pulmonary immaturity seen in newborns[22]. The RDS rate was higher than that reported by a study16 (34%), which may be attributed to the higher CS rate in the current study.

Neonatal jaundice was noted in the current IDMs (34.3%), which was less than a study[16] (57.4 %), and higher than in another study[22] (14.6%). This variation may be attributed to variability in the associated risk factors, such as polycythaemia, sepsis, cephalhaematoma, and incompatibility between blood group and Rh in various study samples.

The current study showed congenital anomalies in 2.9% cases, which were cleft lip and palate, and undescended testis. The finding was far less than what was reported by earlier studyies[7,23]. This may reflect good metabolic control in the current subjects because studies have shown a positive correlation between poor maternal metabolic control and the rate of foetal malformation[23].

The rate of prematurity in the current study was lower than what was reported by studies.[7,16,19] Birth asphyxia was seen in 5.7% of the neonates, which was also less than what other studies reported[16,19,24].

The mortality rate among current IDMs was 2.9%; 1 died due to severe RDS, and the other due to birth asphyxia. Higher mortality rates were reported earlier[19,22].

Gestational age, gender and birthweight of the neonate were significantly associated with severity of hypoglycaemia in the first 1-3 hours of life. Premature babies, girls and those low birthweights had more severe hypoglycaemia. In contrast, a study[25] concluded that boys were more affected by hypoglycaemia than girls. Preterm neonates have minimal glycogen stores as they have not gone through the period of glycogen accumulation that occurs late in pregnancy, making them more susceptible to hypoglycaemia[25]. On the other hand, a study[26] concluded that severe hypoglycaemia was more common among infants born to mothers who needed insulin. This result is close to the current study in which 66.7% of IDMs with severe hypoglycaemia were born to mothers who needed insulin in their pregnancy.

There was no significant difference with respect to neonatal complications in infants of mothers with pre-gestational and gestational diabetes. This is similar to literature[21]. One study[22] also reported similar conclusions except that neonatal hypoglycaemia occurred more commonly in infants of pre-gestational diabetic mothers.

Conclusion

GDM was the commonest type of diabetes among mothers. Pregnancies in diabetic women were linked to an increased risk of neonatal complications. Premature and low birthweight babies had more severe hypoglycaemia in the first 3 hours of life. No significant differences were found when neonatal complications were compared between pregestational and gestational diabetic mothers.

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