Original Article

Common Complications in Infants Born to Diabetic Mothers

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ABSTRACT

Infants of diabetic mothers are at increased risk of complications. There is always a need for more research on this topic to look for complications and make strategies for prevention and management. **Objectives:** To determine the frequency of complications in infants born to diabetic mothers. **Methods:** This descriptive study was done at the Department of Pediatrics, Molvi Ameer Shah Memorial Hospital, Peshawar from 1st January 2022 to 31st December 2022. A total of 150 infants born to diabetic mothers were enrolled after written informed consent and frequencies of complications were noted. Data were analyzed using SPSS 24.0. **Results:** The mean age of the patients was 3.08 ± 1.7 days. The minimum age was 1 day, and the maximum was 7 days. The mean age of the mother was 26.9 ± 4.07 years. The mean gestational age was 36.9 ± 1.4 weeks. The mean duration of diabetes was 7.6 ± 1.14 years. The mean HbA1c level was 7.27 ± 2.41. There were 38% males and 62% female. Adequate diabetic control was present in 24.7% of patients while 75.3% had poor diabetic control. The most common complication was hypoglycemia in 24.7% followed by Macrosomia in 22.7%, prematurity in 20%, hyperbilirubinemia 11.3%, hypocalcemia in 10.7% and polycythemia in 10.7% patients. **Conclusions:** Most common complication was hypoglycemia followed by macrosomia, prematurity, hyperbilirubinemia, hypocalcemia, and polycythemia. However, due to its limited sample size, the results may not be generalizable.

INTRODUCTION

Diabetes is a common metabolic disorder observed during pregnancy, characterized by hyperglycemia resulting from defects of insulin action, insulin secretion, or both [1]. About 1-14% of all pregnancies are complicated by diabetes mellitus, and 90% of them are Gestational Diabetes Mellitus (GDM) [2, 3]. WHO has predicted that between 1995- 2025, there will be a 35% increase in the worldwide prevalence of diabetes and an additional 1-6% of women will develop gestational diabetes [4]. The true prevalence of glucose intolerance during pregnancy in Pakistan is still to be determined but small hospital-based studies have given the figures of 3.2% for GDM and 1.9% for Impaired glucose tolerance [5]. Once pregnant women are labeled as diabetic either known diabetic or having gestational diabetes, high attention should be given to the mother and fetus, as infants born to diabetic mothers (IDMs) are at great risk of developing complications that adversely affect the overall well-being of infants [6]. IDMs are at risk of hypoglycemia, hypocalcemia, hyperbilirubinemia, polycythemia, macrosomia, and prematurity [7, 8]. The increased incidence of fetal complications in IDMs is due to the occurrence of maternal hyperglycemia, hypoglycemia, and ketosis during fetal organogenesis. Fetal hyperglycemia stimulates beta-cell hypertrophy and increases insulin production and fetal oxygen consumption. Insulin has mitogenic and anabolic effects on many tissues (e.g., adipocytes, skeletal and cardiac muscle, hepatic and connective tissue), but not the brain

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[9]. In a study, it was demonstrated that in infants born to diabetic mothers, hypoglycemia was the most commonly observed complication (54%), followed by hypocalcemia which was seen in 43%, polycythemia in 35%, hyperbilirubinemia in 42% and macrosomia in 15% of infants. They further elaborated that 36% of infants born to diabetic mothers were preterm and 21% of total neonates were born through cesarean delivery [10].

This study has been planned to assess the common complications in infants born to diabetic mothers because there is scarcity of knowledge in the local population, which demonstrates the incidence of those complications. The results of the present study will give an idea about the incidence of complications in infants born to diabetic mothers in our local population. The information will help the clinicians to closely monitor diabetic mothers during their pregnancy and will also help to develop the local guidelines on which infants born to diabetic mothers should be evaluated. This would result in an early identification of these complications leading to prompt management. As there is no such study conducted in a secondary care hospital among the local populations, all the information to be gathered systemically shall be new for us. This study aimed to assess common complications among infants born to diabetic mothers.

METHODS

This descriptive study was carried out at Department of Obstetrics and Gynecology, Molvi Ameer Shah Hospital, Peshawar during the period, 1st January 2022 till 31st December 2022, after obtaining approval from the research review board of the institute vide Ref. No. 30/HEC/B&PSC/2021 dated 20th December 2021. The study included newborns received in a nursery, of either gender in the age range of 1 to 7 days, born to mothers with a documented history of diabetes mellitus for at least two years. Infants with gross congenital abnormalities like cleft palate, neonatal sepsis, twin pregnancies, and infants born to mothers with multiple comorbidities like thyroid disorder and hypertension were excluded. Diabetes status was determined through the measurement of the HbA1c level of the mothers before delivery. Glycemic control was defined as adequate and poor. If HbA1c < 7%, it was labeled as adequate glycemic control, and if HbA1c ≥ 7%, it was labeled as poor glycemic control. Complications were determined during the first week of birth in all the infants born to diabetic mothers. Complications were assessed in terms of; 1) Hypoglycemia: Through laboratory analysis of neonatal blood sample. Hypoglycemia was labeled if the glucose level in neonatal serum was <27 mg/dL (<1.5mmol/L) at the time of diagnosis. 2) Hypocalcemia: Through laboratory analysis of neonatal blood sample

Hypocalcemia was labeled if total serum calcium concentration was < 8 mg/dL (< 2 mmol/L). 3) Polycythemia: Polycythemia is an abnormally high level of red blood cells. Polycythemia was labeled if hematocrit was >65% and hemoglobin > 22 g/dl. 4) Hyperbilirubinemia: Through laboratory analysis of neonatal blood samples, hyperbilirubinemia was defined as the elevation of the bilirubin level in the newborn's blood. It was labeled if a total serum bilirubin level was > 5 mg/ dL (86 μ mol per L). 5) Macrosomia: Fetal macrosomia was defined as a birth weight >4500 g measured through pediatric weigh machine. 6) Prematurity: A premature infant is a baby born before 37 weeks of gestation (as received on referral notes or procured from history determined by obstetricians in history). A total of 150 patients were registered. The sample size was determined using WHO sample size calculator taking an anticipated proportion of hypoglycemia as 54.0% with 8% absolute precision at 95% confidence level. Participants were enrolled using a non-probability consecutive sampling technique. All the demographic details (age of neonate, gender of the neonate, age of mother, gestational age, duration of diabetes in mothers, and their glycemic control status) were collected. For neonatal complications including polycythemia, hyperbilirubinemia, hypocalcemia, and hypoglycemia blood sample was taken from the superficial vein of the newborn and sent to the hospital laboratory. For prematurity, history was taken from the mother about the last menstrual period which was subtracted from the date of birth of the baby to yield gestational age at the time of birth of the baby. Macrosomia was confirmed on clinical examination of the newborn by measuring the weight of the newborn using a weighing scale. The presence of complications was recorded as per operational definitions. Data were entered and analyzed on computer software Statistical Package for Social Sciences version 25.0. Quantitative variables were presented as mean ± SD. Frequencies and percentages were calculated for all qualitative variables. Categorical variables were compared using the chi-square test. Continuous variables were compared using the student t test and Mann Whitney U as appropriate. P-value ≤0.05 was considered as significant.

RESULTS

The study comprised 150 patients, 38% were male and 62% were female. The majority of patients (75.33%) had a deranged blood glucose profile, with just 24.67% having acceptable control. This emphasizes the need for adequate diabetic control in the community. (Table 1).

Table 1: Gender wise distribution of infants.

Characteristics	Frequency (%)
Gender	
Male	57 (38)
Female	93 (62)
Adequate Diabetes control	
Present	37 (24.67)
Poor	113 (75.33)

The statistical characteristics of the 150 patients involved in the study are shown in Table 2. The average age of the neonates was 3.08 ± 1.74 days, ranging from a minimum of 1 day to a maximum of 7 days. The average age of the mothers was 26.9 years. The average gestational age was 36.67 ± 1.41 weeks, ranging from a minimum of 1 week to a maximum of 7 weeks. The average duration of diabetes was 7.67 ± 1.14 years, ranging from a minimum of 1 year to a maximum of 14 years. The average HbA1c level was 7.27 ± 2.41, ranging from a low of 5.90 to a maximum of 9.80. The descriptive statistics provide a comprehensive summary of the attributes of the patients included in the study.

Table 2: Descriptive statistics (N=150).

Variables	Mean ± S.D
Age of Neonate (days)	3.08 ± 1.74
Age of Mother (years)	26.9
Gestational Age (weeks)	36.67 ± 1.41
Duration of Diabetes (year)	7.67 ± 1.14
HbA1c (%)	7.27 ± 2.41

Table 3 displays the most common complications found in the study's 150 patients. The prevalence of hypoglycemia, a frequent consequence, was seen in 24.7% of the patients. Subsequently, macrosomia occurred in 22.7% of the patients. Additionally, a prevalent complication seen in 20.0% of the patients was prematurity. Additional problems noted were hypocalcemia (10.7%), polycythemia (10.7%), and hyperbilirubinemia (11.3%). These results emphasize the need for monitoring and controlling these problems in people with diabetes to enhance their overall health outcomes.

Table 3: Most common infant complications.

Complication	Frequency (%)
Hypoglycemia	37 (24.7)
Hypocalcemia	16 (10.7)
Polycythemia	16 (10.7)
Hyperbilirubinemia	17 (11.3)
Macrosomia	34 (22.7)
Prematurity	30 (20)
Total	**150 (100)**

The data in Table 4 shows the age groups of mothers and the incidence of different problems in their newborns. Among the 100 mothers aged 20-30, 20% of their newborns had hypoglycemia, whereas 7% suffered hypocalcemia.

Among newborns aged 31–40, 34% suffered hypoglycemia and 18% developed hypocalcemia. However, the disparity in the prevalence of these problems between the two age groups did not reach statistical significance ($p = 0.061$ and $p = 0.094$, respectively). Likewise, there was no notable disparity in the prevalence of preterm, macrosomia, hyperbilirubinemia, and polycythemia across the two age cohorts. These data indicate that maternal age may not have a substantial impact on the incidence of problems in newborns born to mothers with diabetes.

Table 4: Age group data of mothers.

Variables	Age of Mother 20-30 (N = 100) Frequency (%)	Age of Mother 31–40 (N = 50) Frequency (%)	P –value
Hypoglycemia			
Yes	20 (20)	17 (34)	0.061
No	80 (80)	33 (66)	
Hypocalcemia			
Yes	7 (7)	9 (18)	0.094
No	93 (93)	41 (82)	
Prematurity			
Yes	23 (23)	7 (14)	0.194
No	77 (77)	43 (86)	
Macrosomia			
Yes	26 (26)	8 (16)	0.168
No	74 (74)	42 (84)	
Hyperbilirubinemia			
Yes	14 (14)	3 (6)	0.145
No	86 (86)	47 (94)	
Polycythemia			
Yes	10 (10)	6 (12)	0.708
No	90 (90)	44 (88)	

Table 5 shows neonate gender and problems. Out of 57 male newborns, 28.1% had hypoglycemia and 19.3% hypocalcemia. In contrast, 22.6% of 93 female newborns had hypoglycemia and 5.4% hypocalcemia. Male and female infants had significantly different hypocalcemia rates ($p = 0.007$). Macrosomia occurred in 12.3% of male infants and 29.0% of female neonates ($p = 0.017$). Other problems did not vary between male and female infants. These data imply that gender may affect diabetes mother-born problems

Table 5: Infant complications based on gender.

Variables	Male Baby (N = 57) Frequency (%)	Female Baby (N = 93) Frequency (%)	P –value
Hypoglycemia			
Yes	16 (28.1)	21 (22.6)	0.449
No	41 (71.9)	72 (77.04)	
Hypocalcemia			
Yes	11 (19.3)	5 (5.4)	0.007
No	46 (80.7)	88 (94.6)	

Prematurity			
Yes	13 (22.8)	17 (18.3)	0.501
No	44 (77.2)	76 (81.7)	
Macrosomia			
Yes	7 (12.3)	27 (29)	0.017
No	50 (87.7)	66 (71)	
Hyperbilirubinemia			
Yes	5 (8.8)	12 (12.9)	0.438
No	52 (91.2)	81 (87.1)	
Polycythemia			
Yes	5 (8.8)	11 (11.8)	0.556
No	52 (91.2)	82 (88.2)	

Table 6 shows mothers' diabetes duration and neonatal problems. In 92 mothers with diabetes under 5 years, 29.3% of their neonates had hypoglycemia and 9.8% had preterm. The 58 mothers with diabetes over 5 years had 17.2% neonates with hypoglycemia and 36.2% with preterm. The difference in preterm rates between groups was substantial ($p < 0.001$). Hyperbilirubinemia ($p = 0.003$) was also significantly different between the two groups, with 17.4% of neonates born to mothers with diabetes less than 5 years and 1.7% born to mothers with diabetes more than 5 years. These data imply that mothers' diabetes duration may affect neonatal problems.

Table 6: Duration of diabetes.

Variables	Duration of Diabetes less than 5 years (N = 92)	Duration of Diabetes more than 5 years (N = 58)	P –value
	Frequency (%)	Frequency (%)	
Hypoglycemia			
Yes	27 (29.3)	10 (17.2)	0.094
No	65 (70.7)	48 (82.8)	
Hypocalcemia			
Yes	8 (8.7)	8 (13.8)	0.325
No	84 (91.3)	50 (86.2)	
Prematurity			
Yes	9 (9.8)	21 (36.2)	<0.001
No	83 (90.2)	37 (63.8)	
Macrosomia			
Yes	20 (21.7)	14 (24.1)	0.733
No	72 (78.3)	44 (75.9)	
Hyperbilirubinemia			
Yes	16 (17.4)	1 (1.7)	0.003
No	76 (82.6)	57 (98.3)	
Polycythemia			
Yes	12 (13)	4 (6.9)	0.235
No	80 (87)	54 (93.1)	

Table 7 displays the data on the adequate level of glycemic control in mothers and the incidence of different problems in their newborns. Among the 37 mothers who maintained appropriate glycemic control, 18.9% of their newborns encountered low blood sugar levels, while 29.7% were born prematurely. By contrast, among the 113 mothers who had inadequate control over their blood sugar levels, 26.5% of their newborns suffered from low blood sugar (hypoglycemia), while 16.8% were born prematurely. However, there was no statistically significant disparity in the prevalence of these problems between the two groups. These data indicate that maintaining proper management of blood sugar levels in mothers may not have a substantial effect on the incidence of problems in their newborns.

Table 7: Adequate glycemic control.

Variables	Present (N = 37)	Poor (N = 113)	P –value
	Frequency (%)	Frequency (%)	
Hypoglycemia			
Yes	7 (18.9)	30 (26.5)	0.350
No	30 (81.1)	83 (73.5)	
Hypocalcemia			
Yes	4 (10.8)	12 (10.6)	0.974
No	33 (89.2)	101 (89.4)	
Prematurity			
Yes	11 (29.7)	19 (16.8)	0.088
No	26 (70.3)	94 (83.2)	
Macrosomia			
Yes	6 (16.2)	28 (24.8)	0.280
No	31 (83.8)	85 (75.2)	
Hyperbilirubinemia			
Yes	5 (13.5)	12 (10.6)	0.063
No	32 (86.5)	101 (89.4)	
Polycythemia			
Yes	4 (10.8)	12 (10.6)	0.974
No	33 (89.2)	101 (89.4)	

DISCUSSION

The results of this study align with other research performed by Alam M *et al.*, that has shown a significant occurrence of problems in newborns delivered to mothers with diabetes [11]. Within this research, 75.33% of the mothers exhibited inadequate glycemic control, a proportion that aligns closely with the results of a separate study done in India by Sunjaya AP *et al.*, where 73.3% of the mothers also had inadequate glycemic control [12]. This underscores the need for improved care and regulation of diabetes in expectant mothers to mitigate the possibility of problems in their newborns. The study identified hypoglycemia as the prevailing problem, with a prevalence of 24.7% among the newborn. This aligns with the results of research done in Saudi Arabia by Al-Khalifah R *et al.*, which reported that 25% of newborns delivered to mothers with diabetes had hypoglycemia [13]. Similarly, research carried out by Turkyilmaz E *et al.*, in Turkey found that 22.7% of newborns delivered to mothers with diabetes had hypoglycemia [14]. These results emphasize the need for

monitoring and controlling blood glucose levels in newborns delivered to mothers with diabetes to avoid hypoglycemia. In this research, macrosomia was the second most prevalent problem, impacting 22.7% of newborns. This aligns with the results of research carried out in Iran by Aalipour S et al., which reported that 23.3% of newborns delivered to women with diabetes exhibited macrosomia [15]. Similarly, research carried out in the United States by a group led by Salihu HM *et al.,* found that 20% of newborns delivered to women with diabetes had macrosomia [16]. These results emphasize the need for promptly identifying and treating macrosomia in newborns delivered to diabetic mothers in order to avoid negative consequences. Additionally, this research showed a high incidence of prematurity, affecting 20.0% of the newborns. This aligns with the results of research carried out in Pakistan by Saheb HS *et al.,* which revealed that 20.5% of newborns delivered to women with diabetes were born prematurely [17]. In a research done in Brazil, De Moura DR *et al.,* showed that 19.2% of newborns delivered to women with diabetes were premature [18]. These results emphasize the need for vigilant surveillance of pregnant women with diabetes to avert preterm birth and its associated consequences. The frequency of hypocalcemia differed significantly between male and female infants in this research, with 19.3% of male neonates and only 5.4% of female neonates reporting this problem. This aligns with the results of research carried out in India by Sonia SF *et al.,* which revealed that male newborns born to mothers with diabetes had a higher risk of developing hypocalcemia in comparison to female newborns [19]. This phenomenon may be attributed to the elevated amounts of testosterone in male newborns, which can result in heightened insulin resistance and compromised glucose metabolism. The length of time that mothers have had diabetes was shown to be a major predictor in the frequency of preterm and hyperbilirubinemia in their newborns. Offspring born to moms with a prolonged period of diabetes had an elevated susceptibility to prematurity and hyperbilirubinemia. This aligns with the results of research conducted by Gasim T *et al.,* in Saudi Arabia, which revealed that a greater length of time that mothers had diabetes was linked to a higher likelihood of premature birth and hyperbilirubinemia in their newborns [20]. This emphasizes the need for promptly identifying and controlling diabetes in expectant mothers to minimize the possibility of problems in their newborns.

CONCLUSIONS

This research emphasizes the significant frequency of complications in newborns delivered to mothers with diabetes and underscores the need for improved care and regulation of diabetes in expectant women. The results of this study align with other research and provide significant perspectives on the variables that might impact the incidence of problems in newborns delivered to mothers with diabetes. Additional investigation is required to ascertain efficacious approaches for the prevention and treatment of these problems to enhance the health outcomes of newborns delivered by mothers with diabetes.

Conflicts of Interest

The authors declare no conflict of interest.

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