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A Prospective Study of Neonatal Outcome of Diabetic Pregnancies in A Tertiary Care Hospital

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ABSTRACT

Diabetes mellitus, a chronic metabolic disorder, poses significant risks during pregnancy, particularly gestational diabetes mellitus (GDM) and overt diabetes mellitus (DM). Neonates born to diabetic mothers (IDMs) are at increased risk of congenital anomalies, macrosomia, small for gestational age (SGA), hypoglycemia and other metabolic and hematological complications, this study investigates neonatal outcomes associated with diabetic pregnancies in a tertiary care hospital setting. This hospital-based prospective study was conducted from November 2015 to May 2017 at Vanivilas Children Hospital and Bowring and Lady Curzon Hospital, Bangalore. Neonates of mothers diagnosed with GDM and overt DM (as per DIPSI criteria) were included. A total of 100 neonates were enrolled after obtaining informed consent. Maternal and neonatal data were collected, including maternal HbA1C, neonatal anthropometric parameters, metabolic and hematological complications, and congenital anomalies. Statistical analysis was performed using SPSS Version 25.0. Majority of IDMs (74%) were born to mothers with GDM. Male neonates were predominant (67.56% in GDM and 92.43% in overt DM). Large for gestational age (LGA) neonates were more common in overt DM (57.69%) compared to GDM (15.67%), with significant macrosomia (P = 0.0006). Hypoglycemia was higher in overt DM (88.46%) compared to GDM (54.04%) (P=0.002). Hypocalcemia occurred in 48.63% of GDM neonates and 23.07% of overt DM neonates (P=0.0001). Polycythemia was observed in 52.35% of GDM and 26.9% of overt DM neonates (P=0.001). Hyperbilirubinemia was more prevalent in GDM neonates (44.73%) compared to overt DM neonates (23.07%) (P=0.006). Neonatal complications, including congenital anomalies (75.75%), macrosomia (73.52%) and hypoglycemia (82.5%), were significantly associated with maternal HbA1C >6.5% (P = 0.000). Neonates of diabetic mothers, especially those with overt DM, face significant risks of adverse outcomes. Comprehensive prenatal care, effective glycemic control and multidisciplinary neonatal management are crucial for improving neonatal outcomes.

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Key Words

Neonatal outcome, gestational diabetes, overt diabetes, congenital anomalies, macrosomia, hypoglycemia

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder due to either insulin deficiency (relative or absolute) or due to peripheral resistance to the action of insulin[1]. The World Health Organization estimates that the number of people with diabetes mellitus (DM) will increase from 150 million to 333 million by the year 2025. This alarming increase in the prevalence of DM will occur mainly in the developing regions of the world and the child bearing age would be most affected[2]. The prevalence of GDM in India varied from 3.8-21% in different parts of the country, depending on the geographical locations and diagnostic methods used[3]. The recent data on the prevalence of GDM in our country was 16.55% by WHO criteria of 2 hr PG=140mg/dl[4]. Neonatal mortality rate in diabetic pregnancies is 5 times <that of non-diabetic pregnancies. Neonates born to diabetic mothers are at increased risk of developing congenital anomalies, macrosomia, small for gestational age (SGA), metabolic abnormalities like hypoglycemia, hypocalcaemia, hypomagnesemia, haematological complications like hyperbilirubinemia, hyper viscosity secondary to polycythemia, respiratory distress due to antagonistic effect of hyperinsulinemia on cortisol mediated surfactant synthesis[5]. Prevalence of congenital anomalies in infants of diabetic mothers is 6-10%. Most common fetal structural defects associated with maternal diabetes are Cardiac malformations, Neural tube defects, renal agenesis and skeletal malformations. Cardiac anomalies include asymmetric septal hypertrophy. Cardiomegaly occurs in 30% and cardiac failure in 5-10% of such neonates. Macrosomia results in increased incidence of operative deliveries and shoulder dystocia with potential brachial plexus injury[5]. Strict glycemic control during peri-conception and during labour reduce incidence of anomalies and neonatal hypoglycemia respectively. Since the incidence of gestational diabetes is increasing which in turn increasing the incidence of adverse neonatal outcome, there is a need for study.

MATERIALS AND METHODS

It was a Hospital based prospective study conducted in Neonates of mothers diagnosed to have gestational diabetes mellitus and overt DM admitted at Vanivilas Children Hospital and Bowring and Lady Curzon hospital attached to Bangalore Medical College and Research Institute from November 2015-May 2017. All neonates of mothers diagnosed to have gestational diabetes mellitus and overt diabetes were enrolled for this study.

Sample Size:

$n=p,\ q=\frac{99.64}{d^2}$

p=0.47, prevalence

q=1-p

d=error, 5%

100 infants of diabetic mothers were studied.

Methodology: With prior Informed consent obtained from the parents/guardians of neonates under study who fulfill the mentioned criteria, the maternal data was recorded including age, parity, gestational age, mode of delivery and the outcome Maternal diabetes was diagnosed based on diabetes in pregnancy study group in India (DIPSI) criteria. It requires a 2-h venous plasma glucose ≥140mg/dl in the non-fasting Oral Glucose Tolerance Test (OGTT). Neonatal data including APGAR score, birth weight, sex and gestational age was recorded, a screening physical examination for the presence of major congenital anomalies is performed. Serial blood glucose levels are checked at1, 2, 3, 6, 12, 24 and 48 hours by glucometer. Serum calcium and complete haemogram was done routinely at 24 hours of age and later if required. Echocardiography was done for all the infants. Other investigations were carried out as indicated. Macrosomia is defined as birth weight more than 90th percentile (large for gestational age, LGA), fetal growth restriction as birth weight less than the 10th percentile (small for gestational age, SGA). Hypoglycemia as blood glucose of >40 mg/dl, hypocalcaemia as serum calcium level of >7 mg/dl. Polycythemia as hematocrit higher than 65% or hemoglobin (Hb) concentration <20gm/dl. Major congenital anomaly is defined as one which is any of the following. lethal, life-shortening, life-threatening, requires major surgery or affecting in a significant way the quality of life.

Inclusion Criteria:

- Singleton neonates of diabetic mothers.

Exclusion Criteria:

- Neonates of diabetic mothers with medical complications such as heart disease and renal disease.
- Neonates of diabetic mothers with pregnancy induced hypertension and eclampsia.
- Twin neonates of diabetic mothers.

Statistical Analysis: Data was analyzed using statistical software SPSS (Version 25.0). The following statistical techniques was employed.

- **Descriptive Analysis:** To summarize demographic and clinical characteristics.
- **Regression Analysis:** To identify predictors of clinical outcomes and correlations between microbial patterns and patient recovery.
- **Chi-Square Tests:** To evaluate associations between categorical variables, such as specific bacterial species and treatment outcomes.

RESULTS AND DISCUSSIONS

As per (table 1) in this study majority of neonates studied are (50 GDM and 24 overt diabetic mothers) males.

Table 1: Sex Distribution and Diabetic Status

	Diabetic status	
Gender	**GDM (n=74)**	**Overt DM (n=26)**
Male	50(67.56%)	24(92.43%)
Female	24(32.43%)	02(7.69%)
Total	74(100.0%)	26(100.0%)

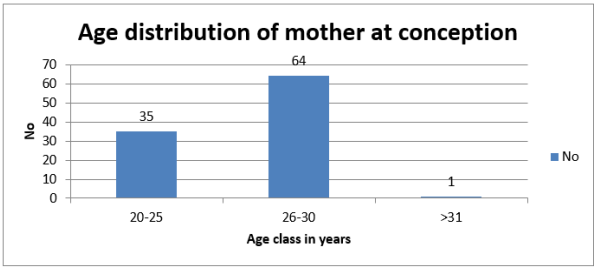

Fig. 1: Age Distribution of Mother at Conception

Table 2: Distribution of Weight for Gestational Age and Diabetic Status

	Diabetic status		
Birth weight	**GDM (n=74)**	**Overt DM (n=26)**	**P-value**
SGA	04(5.40%)	02(7.69%)	P=0.0006
AGA	51(67.310%)	09(34.64%)	
LGA	19(15.67%)	15(57.69%)	
Total	74(100.0%)	26(100.0%)	

As per (table 3) this study shows that majority 67.31% in GDM are AGA and majority 15 (57.69%) out of 26 of overt DM are LGA which is statistically significant.

Table 3: Distribution of Metabolic Complications and Diabetic Status

	Diabetic status		
Metabolic complications	**GDM n=74**	**Overt DM n=26**	**P value**
Hypoglycemia			
Present	40 (54.04%)	23(88.46%)	P=0.002
Absent	34(45.94%)	03(11.53%)	
Hypocalcaemia			
Present	36(48.63%)	06(23.07%)	P=0.0001
Absent	38(51.35%)	20(76.92%)	

This study showed the incidence of hypoglycemia was most common in infants of overt diabetic mothers (88.46%) when compared to infants of GDM (54.04%) which is statistically significant. Of the 63 IDMs with hypoglycemia, 52 (82.5%) occurred within 6 hrs of life, 31 (49.2%) in the 1st hour, 11 (17.46%) between 6 and 24 hrs. 12 of the infants were symptomatic and 2 required GIR and remaining were treated with gavage feeding

Table 4: Distribution of Hematological Complications and Diabetic Status

	Diabetic status		
Hematological complications	**GDM (n=74)**	**Overt DM (n=26)**	**P value**
Polycythemia			
Present	38(52.35%)	7(26.9%)	P= 0.001
Absent	36(48.64%)	19(73.03%)	
Hyperbilirubinemia			
Present	34(44.73%)	06(23.07%)	P=0.006
Absent	40(54.05%)	20(76.92%)	

This study showed, the occurrence of polycythemia is more in 38 (58.35%) infants of GDM as compared to the infants 7 (26.9%) of overt DM and is statistically significant. Of which 9 in whom heamatocrit was between 70-75% were managed conservatively with hydration. 3 were symptomatic and treated with partial exchange transfusion with normal saline.

Table 5: Distribution of Congenital Anomalies and Diabetic Status

	Diabetic status		
Congenital anomalies	**GDM (n=74)**	**Overt DM (n=26)**	**P-value**
Cardiovascular system			
Present	11(14.86%)	19(73.07%)	P=0.008
Absent	63(85.13%)	07(26.9%)	
Central nervous system			
Present	00(%)	02(07.6%)	P=0.0002
Absent	74(%)	24(92.3%)	
Renal system			
Present	00(%)	01(3.8%)	P=0.0014
Absent	74(%)	25(96.15%)	

This study showed that, the occurrence of cardiovascular anomalies was more in infants 19 (73.07%) of overt DM when compared to infants 11 (14.86%) of GDM mothers which is statistically significant. CNS anomaly 2 (7.6%) and renal anomaly 1 (3.8%) occurred in infant of overt diabetic mothers.

Table 6: Distribution of Neonatal Deaths and Diabetic Status

	Diabetic status		
Deaths	**GDM**	**Overt DM**	**P value**
Present	01(4.05%)	02(7.7%)	P=0.002
Absent	73(95.94%)	24(92.3%)	
Total	74(%)	26(100%)	

This study shows that the mortality is more in infants of overt diabetic mothers 2 (7.7%) which is statistically significant.

Table 7: Correlation of Neonatal Complications in Relation to Maternal HbA1C Levels

	HbA1C <6.5 n=29	**HbA1C >6.5 n=71**	**P-value**
Congenital anomalies			
Present n=33	08(24.24%)	25(75.75%)	P=0.000
Absent n=67	21(31.34%)	46(68.65%)	
Macrosomia			
Present n=34	9(26.47%)	25(73.52%)	
Absent n=66	20(30.30%)	46(69.69%)	
Hypoglycemia			
Present n=63	11(17.45%)	52(82.5%)	
Absent n=37	18(48.64%)	19(51.35%)	

This study showed that the occurrence of congenital anomalies are significantly more in mothers with HbA1C level >6.5% (88.57%). The occurrence of macrosomia (48%) is also significantly more in mothers with HbA1C levels >6.5% which also shows significant correlation with hypoglycemia. In India, while the most pressing and commonest problem is high risk pregnancies, of which DIABETES is a common medical complication of pregnancy. Women with this complication can be separated into those who were known to have diabetes before pregnancy (pregestational) and those diagnosed during pregnancy (gestational). WHO estimates an alarming increase in the prevalence of DM, which will occur mainly in the developing regions of the world and the child bearing

age would be most affected. The presence of diabetes before pregnancy is a risk factor for adverse neonatal outcomes, especially congenital anomalies. Studies by Haider shirazi[6]. Closely resembles our study which focused mainly on comparison of complications in neonates born to pregestational and gestational DM mothers, on other hand Joenne Yang[7] and Sheffield[8] on congenital anomalies. The present study correlates with other studies in which the occurrence of infants born to gestational diabetic mothers is 74% and that of pre gestational diabetic mothers is 26%. Of this 26 all were of type II diabetes. Similar observation was made in other studies[9], Haider Shirazi[6]. This increase in occurrence of pre gestational diabetes is because of recent increase in the prevalence of DM especially affecting the child bearing age. In this present study, majority of the IDMs were males 74%. We report a very high rate of LGA infants (macrosomia) is 34% which is similar to other studies. Macrosomia, a clinical sign of poor diabetic control. This high figure may be due to the effect of hyperglycemia which largely manifests in the 3rd trimester leading to fetal over growth during this period. It was significant to note that almost all the birth injuries occurred in the macrosomic babies, 8/16 (50%). Another significant association between macrosomia and congenital anomalies 20/33 was noticed in our study. In the present study the growth restricted babies were 6% which was similar to the study done b Farooq[10] and different from that of Haider shirazi[6]. where the occurrence of SGA was 18%, this may be due to the enrollment of all mothers with diabetes in this study and our study excluded mothers with other pregnancy and medical complications. Our study shows that the occurrence of hypocalcaemia was 46% in the IDMs of which it occurred more in neonates born to GDM, which is statistically significant. The occurrence of hypocalcemia was significantly high in infants born to overt DM mothers in the study done by Haider[6]. This difference may be because of more preterm infants, as the study included all mothers with diabetes during pregnancy. Preterm by itself is risk factors for hypocalcaemia. In the present study, the occurrence of hyperbilirubinemia (40%) was statistically significant in infants born to GDM, may be because of significant polycythemia which is a risk factor of hyperbilirubenemia. This was different from the study done by Haider shirazi[6] 8.8%, the occurrence of which was not significant in either group. HbA1C is considered to be a good indicator of the glycemic control of the mothers. In our study 52% of the diabetic mother had HbA1C >6.5%. This level had significant association with Macrosomia, congenital anomalies. We observed that 25/33(73%) of congenital anomalies and 25/34 of macrosomia was associated with HbA1C levels >6.5%. Various studies have also contributed that the poor glycemic control of the diabetic mothers and the fetal hyperinsulinemia directly contribute to the occurrence of congenital anomalies and macrosomia[11,12].

CONCLUSION

It is of concern that despite improvement of care for diabetic mothers recently, there is not a significant improvement in the outcome. Of all the pregnancies complicated by diabetes, overt DM continues to have a major contribution. The occurence of congenital malformations and mortality was more significant in offsprings of women with pre gestational diabetes. Our results suggest that the morbidities/ complications in IDMs such as macrosomia, birth injuries and congenital anomalies had a significant association with hypoglycemia in neonates and poor glycemic control in mothers.

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