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OUTCOME OF INFANTS BORN TO DIABETIC MOTHER IN A TERTIARY CARE HOSPITAL

Deepnwita Patra[1], Pradeep Kumar Jena[2], Mangal Charan Murmu[3], Banashree Swain[4] & Shreesh Bhat[5]

[1]Resident Physician, Department of Pediatrics, S C B Medical College, Cuttack, India

[2,3]Associate Professor, Department of Pediatric, S C B Medical College, Cuttack, India

[4]Assistant Professor, Department of Biochemistry, S C B Medical College, Cuttack, India

[5]Research Scholar, Department of Pediatric, SCB Medical College, Cuttack, India

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ABSTRACT

Introductions: *Diabetes Mellitus (DM) complicates 35 % of all pregnancies. Type 2 DM, the most common form of DM is characterized with later onset in life, peripheral insulin resistance, relative insulin deficiency, obesity and the development of vascular, renal and neuropathic complications. More than half of the women who develop Gestational Diabetes Mellitus (GDM), which represents approximately 90 % of all cases of diabetes complicating pregnancy, will develop type 2 DM later in life.*

Aim & Objectives: *To know the complications in infants of diabetic mothers.*

Materials & Methods: *All consecutive singleton live born babies born to diabetic mothers in SCB MCH and infant of diabetic mothers who were admitted to our hospital within 24 hours of birth during the study period (October 2017 to September 2019) formed the study population. It is a hospital based Cross-sectional study.*

Results: *Hypoglycemia was the commonest complication observed in 57.4 % IDMs followed by respiratory distress, macrosomia and hypocalcemia, each constituting 37 %. Birth injury in the form of Erb's palsy was the least common complication accounting for 1.9 %. There was no statistically significant difference in the complications seen in the infants born to mothers with pre-gestational and gestational diabetes. However, there was significant relationship between some complications such as hypoglycemia and macrosomia seen in IDMs with maternal glycemic control. The incidence of respiratory complications was more in IDMs, born to mothers with suboptimal glycemic control 25 %, whereas it was 13.6 % in optimal glycemic control group. Congenital anomalies were present in 13 % of infant of diabetic mother, out of which 57.1 % had cardiac anomalies. Overall, incidence of cardiac anomalies was 7.4 %; 1 case each of PDA, ASD, VSD and MR with cleft mitral valve was observed. 1IDM with Hydroureteronephrosis, 1 IDM with cleft lip and 1 IDM with CTEV was noted in our study. In the present study, 51 (94.5 %) IDMs survived and mortality was around 5.5 %.*

Conclusions: *Neonatal complications are more common in women with suboptimal glycemic control; management goals in pregnancies complicated by Diabetes Mellitus should be able to achieve optimal glycemic control. With appropriate care and management of diabetes during pregnancy, the perinatal outcome of infants of diabetic mother can be improved.*

KEYWORDS: *Infant, Hypoglycemia, Gestational Diabetes Mellitus*

INTRODUCTION

Diabetes is the most common medical complication of pregnancy. Women can be separated into those who were known to have diabetes before pregnancy–pre-gestational or overt and those diagnosed during pregnancy-gestational diabetes [1]. Diabetes Mellitus complicates 35 % of all pregnancies [2]. Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance that begins or is first detected during pregnancy. Depending on the population sample and diagnostic criteria, the prevalence may range from 114 %. GDM represents nearly 90% of all pregnancies complicated by diabetes [3]. Excellent glucose control was essential to fetal welfare and high glucose content of placental blood was associated with excessive fetal growth [4]. Fetuses of diabetic mothers are at significantly greater risk for spontaneous abortion, stillbirth, congenital malformations and perinatal morbidity and mortality. Subsequently, advances in maternal and fetal care have improved the outlook of the infant of a diabetic mother [5]. Infants born to Diabetic Mother (IDM) are at increased risk of complications which may be periconceptional, fetal, neonatal and even long term [5]. Infants of diabetic mother are at higher risk of complications like macrosomia, hypoglycemia, hypocalcemia, hypomagnesemia, polycythemia, hyper bilirubinemia, prematurity, transient tachypnea of newborn, respiratory distress syndrome, birth asphyxia, congenital heart diseases like interventricular septal hypertrophy, transient hypertrophic subaortic stenosis, cardiomyopathy, cleft lip, cleft palate, sacral agenesis, jitteriness, seizures, movement disorders[6].The causes of the fetal and neonatal sequelae of maternal diabetes are likely multifactorial; however, many of the prenatal complications can be traced to the effect of maternal glycemic control on the fetus and can be prevented or at least reduced through meticulous prenatal and intrapartum care. Several well-done epidemiologic studies have demonstrated a strong association between maternal glycemic control at the time of conception and during early gestation and the incidence of congenital anomalies [5].

Although in developed countries, there has been significant improvement in the outcome of diabetic pregnancies due to better metabolic control before and during pregnancy and better neonatal care, the management in developing country still poses a major challenge. Due to increased perinatal morbidity and mortality, IDM babies should be closely monitored. The present study was conducted in infants born to diabetic women at SCB Medical College & Hospital, Cuttack. The complications in IDMs with reference to HbA1c level in their mother were studied and a comparison was made between babies born to mothers with pre-gestational diabetes and gestational diabetes.

AIM & OBJECTIVES:

To know the complications in infants of diabetic mothers with special reference to HbA1c level in mother, compare the complications between babies born to mothers with pre-gestational diabetes and gestational diabetes and its outcome.

MATERIALS & METHODS

All consecutive singleton live born babies born to diabetic mothers in SCB MCH and infant of diabetic mothers who were admitted to our hospital within 24 hours of birth during the study period (October 2017 to September 2019) formed the study population. Data regarding the diabetic status of the mother was obtained from antenatal records. Diabetic mothers were grouped into two categories: pre-gestational (type I DM and type Il DM) and gestational DM. GDM was defined as any degree of glucose intolerance with onset or first recognition during pregnancy[3] GDM diagnosis was made, if plasma glucose values exceed 75gm oral glucose tolerance test[6]:

- Fasting: 95 mg / dl (5.3 mmol / l)
- 1 hour: 180 mg / dl (10 mmol / l)
- 2 hours: 155 mg / dl (8.6 mmol / l)

The glycemic status of the diabetic mothers during pregnancy was ascertained based on their HbA1c level. The mothers with HbA1c levels <6.5 % were labeled as having a optimal glycemic control whereas mothers with HbA1c levels ≥6.5 % were grouped as having unsatisfactory glycemic control[1].

The Selection of the Cases and the Procedures Adopted in this Work are Detailed Below.

Study Design: Hospital based Cross-sectional study

Sample Size: 54 IDMs.

SELECTION OF SUBJECTS

Inclusion Criteria

All consecutive singleton live born neonates of diabetic mothers presenting within 24 hours to special newborn care unit (SNCU) / NB Ward, from October 2017 to September 2019 were included under this study.

Exclusion criteria: 1.Babies born to diabetic mothers presenting after 24 hours of delivery.2.Babies born to diabetic mothers having following problems: i. Heart disease and Renal disease, ii. Twin Pregnancy.

METHODS

After acquiring the required approval from the ethics committee, we began data collection at the fore mentioned place, of the patients fulfilling the criteria after taking written consent. Babies born to diabetic mothers were evaluated immediately after birth or within 24 hours of birth. Those requiring resuscitation were resuscitated according to Neonatology Resuscitation programmed. Birth asphyxia was defined as an apgar score of< 7 at 1 minute of age [7]. All babies born to diabetic mothers were then shifted to SNCU for monitoring and treatment.

At admission, weight was recorded using digital weighing scale (to nearest 10gms). Gestational age assessment was done by modified Ballard score. Macrosomia was defined as either birth weight greater than the 90th centile for gestational age or > 4000 gm [6]. Small for gestational age was defined as birth weight less than the 10th centile for GA. Data regarding detailed examination of the new born was collected in a preformed performed. Congenital anomalies were identified clinically and supported by Echocardiography. Respiratory distress was defined as respiratory rate of greater than 60 / min and / or presence of sub costal and inter costal retractions.

At admission, blood glucose estimation was done on venous blood by glucose oxidase method. Subsequent blood glucose estimation at 2, 6,12,24,48 and 72 hours of postnatal age was done by glucose dextrostix. Hypoglycemia was defined as a blood glucose level less than 40mg / dl in any infant [8].

Estimation of hemoglobin, hematocrit and serum calcium levels were done in clinical laboratory by automated analyser. Polycythemia was diagnosed, if venous hematocrit was greater than 65 % [5, 9]. Hypocalcemia was defined as serum calcium level less than 7mg / dl or an ionized calcium level of < 4mg / dl (1mmol / L) [10]. Bilirubin level

estimation was done at the onset of clinical jaundice and repeated if necessary. If jaundice was not clinically evident, then serum bilirubin estimation was done on day 4 of life. Hyperbilirubinemia was diagnosed based on standard guidelines.

Chest x-ray and electrocardiography (ECG) was done for the babies if required, and findings were recorded. Echocardiography was done for the infants in whom there was high suspicion of cardiac disease using Nada's Criteria and pulse oximetry showing saturation of < 90 % in any one extremity, or less than 95 % in both extremities or difference between pre and post ductal saturation of > 3 % in three separate measurements taken 1 hour apart, by an experienced cardiologist using standard 2D- echocardiography and findings recorded [11].

STATISTICAL METHODS

Categorical variables are expressed as number of patients and percentage of patients and compared across the groups using Fisher's Exact Test / Pearson's Chi Square test for Independence of Attributes as appropriate. The statistical software, SPSS version 20 has been used for the analysis. An alpha level of 5% has been taken, i.e. if any p value is less than 0.05, it has been considered as significant.

OBSERVATIONS

Table 1 shows 54 infants formed the study sample. Out of 54 infants, 30 were male (55.6 %) and 24 were female (44.4 %).

Table 2 shows In our study out of 54 diabetic mothers, 12(22.2 %) were having pre-gestational diabetes and 42(77.8 %) were having gestational diabetes mellitus. 32 mothers with diabetes had HbA1c ≥6.5 % which was considered as suboptimal and 22 mothers had HbA1c levels <6.5 % which was considered as optimal. In the present study, we observed that suboptimal glycemic control was seen in 9 (75 %) mothers with pre-gestational diabetes and in 23 (54.8 %) mothers with gestational diabetes.

Table 3 shows among the diabetic mothers, 28 were on insulin (51.9 %), 18 were on diet (33.3 %) and 8 were on oral medications (14.8 %).

Table 4 shows Term deliveries are more common among gestational diabetic mothers (59.5 %) as compared to pre-gestational diabetic mothers (33.3 %) though there is no significant statistical difference among the two groups.

In our study in suboptimal glycemic control group, term deliveries (59.4 %) are comparatively more as compared to preterm deliveries (40.6 %) with median gestational being 37 weeks and mean being 36.19 weeks. Among optimal control group, the incidence of term and preterm IDMs are almost similar. Median gestational age being 36 weeks and mean being 35.68 weeks. There were 3 outliers in optimal glycemic group. 2 were born at 28 weeks and 1 IDM was born at 30 weeks as evident in the box and whisker plot.

Table 5 shows Low birth weight (< 2.5kg) was observed in 20.4 % of the babies and birth weight > 4kg was seen in 22.2 % of the babies. In the optimal glycemic group mean baby weight at birth was around 2.65 kg and median was 2.78 as compared to mean weight of 3.29 kg and median of 3.5 kg in suboptimal group.

Table 6 Shows 3(25 %) LGA (Large for gestational age) babies were born to mothers with pre-gestational diabetes and 17 (40.5 %) LGA babies were born to mother with gestational diabetes. The incidence of LGA babies as compared to AGA (Appropriate for Gestational Age) babies is less common in both pre-gestational and gestational diabetic

mothers. There was no significant statistical difference in the incidence of LGA and AGA between the two groups. In our study, we didn't encounter any SGA (Small for Gestational Age) babies.

The incidence of LGA babies among mothers with suboptimal glycemic control is 18 (56.2 %) which is more as compared to incidence of LGA babies in mothers with optimal glycemic control 2 (9.1 %).There was significant statistical difference between the two groups with regard to birth weight for gestational age, as evidenced by p value < 0.001.

Table 7 Shows In our study, complications were seen in 46 out of 54 (85.2 %) IDM babies in different permutation and combinations. Hypoglycemia was the commonest complication seen in 31 (57.4 %) IDMs followed by respiratory distress, hypocalcemia and macrosomia in 20 IDM's each (37 %).

Birth injury in the form of Erb's palsy was seen in only 1 IDM which was the least common complication.

3 babies died from the study sample. 2 died due to severe birth asphyxia (1died at 60 hrs and other died at 48hrs) and 1 baby died due to prematurity with sepsis (at 72 hours of life).

Table 8 Shows Neonatal morbidities were studied in 54 IDMs, of which, 12 were born to pre-gestational diabetics and 42 were born to gestational diabetics. In our study, we have observed that hypoglycemia was the commonest complication in IDMs irrespective of whether mother had gestational diabetes (57.1 %) or pre-gestational diabetes (58.3 %). Respiratory distress was more common in infants born to pre-gestational diabetic mothers (58.3 %) as compared to GDM (31 %); similarly incidence of congenital anomalies was more in pre-gestational diabetic mothers (25 %), as compared to gestational diabetic mothers (9.5 %). Macrosomia was more common in gestational diabetics (40 %). Birth injury was seen in only 1 (8.3 %) infant born to pre-gestational diabetic mother. No statistically significant difference was seen between the two groups.

Table 9 shows Hypoglycemia was observed in 22.7 % and 81.2 % of IDMs born to mothers with optimal glycemic control and suboptimal glycemic control respectively. Incidence of macrosomia in suboptimal glycemic control was around 56.3 %, as compared to 9.1 % incidence in optimal glycemic control. All complications are mostly seen among IDMs born to mothers with suboptimal glycemic control which is defined as HbA1c $\geq$ 6.5%, however there is no significant statistical difference among the two groups except for incidence of hypoglycemia and macrosomia.

Table 10 shows in our study, we have encountered 31 IDMs with hypoglycemia. There was no significant statistical association between hypoglycemia and birth weight. 75 % of babies with birth weight $\geq$4kg had hypoglycemia.

Table 11 shows Hypoglycemia was most commonly observed in IDMs at less than 6 hours of postnatal age (40.7 %) whereas, it was less common at 624 hours (13 %)and 2448 hours (3.7 %) of post natal age. There was significant statistical difference between postnatal ages in hours with regard to hypoglycemia.

Table 12 shows Congenital anomalies were observed in 25 % of IDMs born to pre-gestational diabetes mellitus and 9.5 % of IDMs born to gestational diabetic mothers. There was no significant statistical difference in between the groups with regard to congenital anomalies.

In our study, we encountered congenital anomalies in 13 % of IDMs, out of which 57.1 % had heart disease, with overall incidence of 7.4 %. 1 case each of PDA, ASD, VSD and MR with cleft mitral valve was observed. We had 1IDM with Hydro-uretero-nephrosis, 1 IDM with cleft lip and 1 IDM with CTEV.

Table 13 shows 4.5 % IDMs born to mother with optimal glycemic control had congenital anomaly, whereas 18 % IDMs were born to mother with suboptimal glycemic control. There was no significant statistical difference in between the groups with regard to congenital anomalies.

Table 14 shows Respiratory problems were seen in 25 % of IDMs born to pre-gestational diabetic mothers, whereas it was present in 19 % of IDMs born to gestational diabetic mothers. RDS was only seen in 2 IDMs born to Pre-gestational diabetic mothers, incidence of TTN was quite similar in both the groups. Pneumonia was seen in 3 IDMs, born to gestational diabetic mothers.

The incidence of respiratory complications was more in IDMs, born to mothers with suboptimal glycemic control. RDS was only seen in 2(6.2 %) infants born to mother with suboptimal glycemic control. Incidence of pneumonia(6.2 %) and TTN(12.5 %) was more in IDMs born to suboptimal glycemic control group, as compared to IDMs born to optimal glycemic control group. There was no significant statistical difference between the two groups with regard to respiratory complications.

Table 15 shows Hairy pinna was observed in 31 (57.4 %) IDMS. It was seen in 66.7 % of Pre-gestational Diabetes Mellitus and 54.8 % of gestational diabetic mothers. There was no significant statistical difference between the two groups with regard to hairy pinna.

There was no significant statistical difference with regard to hairy pinna between the two groups.

Table 16 shows Out of 54 IDMs, 11(20 %) required NICU admission. Three IDMs had died in our study. 2 died due to birth asphyxia (1died at 60 hrs and other died at 48 hrs) and the 3rd IDM died due to prematurity with sepsis at 72 hours of life.

Table 1: Sex Wise Distribution of the Study Sample

Sex	Frequency	Percent
Female	24	44.4
Male	30	55.6
Total	**54**	**100.0**

Table 2: Maternal Glycemic Control in Pre-Gestational and Gestational Diabetes Mellitus

Glycemic Control		DM		Total (%)	p Value
		Pre-gestational Diabetes (%)	Gestational Diabetes(%)		
HBA1C	Optimal (< 6.5 %)	3 (25)	19 (45.2)	22 (40.7)	0.208
	Suboptimal (≥ 6.5 %)	9 (75)	23 (54.8)	32 (59.3)	
Total (%)		**12 (100)**	**42 (100)**	**54 (100)**	

Table 3: Type of Treatment Received by Mother During Pregnancy

Insulin / Diet / Oral Medications	Frequency	Percent
Insulin	28	51.9
Diet	18	33.3
Oral medications	8	14.8
Total	54	100.0

Table 4: Distribution of Study Sample Based on Gestational Age

Category	Types	Gestational Age		Total	P Value
		<37 Weeks	37 Weeks		
DM	Pre-gestational Diabetes (%)	8(66.7)	4(33.3)	12(100)	0.109
	Gestational Diabetes (%)	17(40.5)	25(59.5)	42(100)	
	Total (%)	**25(46.3)**	**29(53.7)**	**54(100)**	
Glycemic Control	Sub optimal (%))	12(54.5)	10(45.5)	22(100)	0.313
	Optimal (%)	13(40.6)	19(59.4)	32(100)	
	Total (%)	**25(46.3)**	**29(53.7)**	**54(100)**	

Table 5: Distribution of IDM Babies as Per Birth Weight

Baby Wt(Kg)	Frequency	Percent
< 2.5kg	11	20.4
2.53kg	16	29.6
33.5kg	7	13.0
3.54kg	8	14.8
≥ 4kg	12	22.2
Total	**54**	**100.0**

Table 6: Distribution of Study Sample Based on Birth Weight for Gestational Age

Category	Types	Birth Weight for Gestational Age		Total (%)	p-value
		AGA	LGA		
DM	Pre-gestational Diabetes (%)	9(75)	3(25)	12(100)	p=0.522
	Gestational Diabetes (%)	25(59.5)	17(40.5)	42(100)	
	Total(%)	**34(63)**	**20(37)**	**54(100)**	
Glycemic Control	Optimal (%)	20(90.9)	2(9.1)	22(100)	p<0.001
	Suboptimal(%)	14(43.8)	18(56.2)	32(100)	
	Total (%)	**34(63)**	**20(37)**	**54(100)**	

Table 7: Complications Seen in Infants of Diabetic Mothers

Complications(n=54)	Frequency	Percent
Hypoglycemia	31	57.4
Hypocalcemia	20	37
Respiratory Distress	20	37
Macrosomia	20	37
Hyperbilirubinemia	19	35.2
Polycythemia	15	27.8
Birth Asphyxia	10	18.5
Congenital Anomalies	7	13
Birth Injuries	1	1.9

Table 8: Comparison of Complications in Babies Born to Mothers with Pre-Gestational with Gestational Diabetes Mellitus

Complications (n=54)	DM		Total (%)	p Value
	Pre-gestational Diabetes (%)	Gestational Diabetes (%)		
Hypoglycemia	7(58.3)	24(57.1)	31(57.4)	0.941
Respiratory Distress	7(58.3)	13(31)	20(37)	0.101
Hypocalcemia	5(41.7)	15(35.7)	20(37)	0.744
Hyperbilirubinemia	6(50)	13(30.9)	19(35.2)	0.307
Macrosomia	3(25)	17(40.5)	20(37)	0.328
Polycythemia	3(25)	12(28.6)	15(27.8)	0.808
Birth Asphyxia	2(16.7)	8(19)	10(18.5)	0.851
Congenital Anomalies	3(25)	4(9.5)	7(13)	0.175
Birth Injuries	1(8.3)	0(0)	1(1.9)	0.222

Table 9: Comparison of Complications in Babies Born to Mothers with Hba1c Leve ≥ 6.5 % (Suboptimal Glycemic Control) and Hba1c <6.5 % (Optimal Glycemic Control)

Complications	Glycemic Control		Total (%)	p Value
	Optimal (%)	Suboptimal (%)		
Hypoglycemia	5(22.7)	26(81.2)	31(57.4)	<0.001
Respiratory Distress	5(22.7)	15(46.9)	20(37)	0.071
Hypocalcemia	6(27.3)	14(43.7)	20(37)	0.218
Macrosomia	2(9.1)	18(56.2)	20(37)	<0.001
Hyperbilirubinemia	7(31.8)	12(37.5)	19(35.2)	0.667
Polycythemia	6(27.2)	9(28.1)	15(27.8)	0.845
Birth Asphyxia	3(13.6)	7(21.9)	10(18.5)	0.501
Congenital Anomalies	1(4.5)	6(18.7)	7(13)	0.220
Birth Injuries	0(0)	1(3.13)	1(1.8)	0.593

Table 10: Hypoglycemia in IDMs in Relation to Birth Weight

Parameters		Hypoglycemia	
		Absent (%)	Present (%)
Baby Wt(Kg)	< 2.5kg	5(45.5)	6(54.5)
	2.53kg	7(46.7)	9(53.3)
	33.5kg	3(42.8)	4(57.2)
	3.54kg	5(62.5)	3(37.5)
	≥ 4kg	3(25)	9(75)
Total		**23(100)**	**31(100)**

p=0.599

Table 11: Postnatal Age in Hours and Incidence of Hypoglycemia

		Time			Total	p Value
		≤ 6 hrs	624 hrs	> 24 hrs		
Hypoglycemia	Absent	32 (59.3)	47 (87)	52 (96.3)	131 (80.9)	<0.001
	Present	22 (40.7)	7 (13)	2 (3.7)	31 (19.1)	
Total		**54 (100)**	**54 (100)**	**54 (100)**	**162 (100)**	

Table 12: Congenital Anomalies in Infants of Pre-Gestational and Gestational Diabetes Mellitus

Congenital Anomalies		DM		Total (%) (n=54)
		Pre-gestational Diabetes (n=12) (%)	Gestational Diabetes (n=42) (%)	
	ASD	1 (8.3)	0 (0)	1 (1.8)
	MR	0 (0)	1 (2.4)	1 (1.8)
	VSD	0 (0)	1 (2.4)	1 (1.8)
	PDA	0 (0)	1 (2.4)	1 (1.8)
	Others	2 (16.7)	1 (2.4)	3 (5.6)
Total (%)		**3 (25)**	**4 (9.5)**	**7 (12)**

p=0.075(NS)

Table 13:Maternal Glycemic Control and Congenital Anomalies in Infants Born to Diabetic Mother

Congenital Anomalies	Optimal (%) (n=22)	Suboptimal (%) (n=32)	Total (%)
ASD(Atrial Septal Defect)	0 (0)	1 (3.1)	1 (1.8)
MR(Mitral Regurgitation)	1(4.5)	0 (0)	1 (1.8)
VSD(Ventricular Septal Defect)	0 (0)	1 (3.1)	1 (1.8)
PDA(Patent Ductus Arteiosus)	0 (0)	1 (3.1)	1 (1.8)
Others	0 (0)	3 (9.4)	3 (5.7)
Total (%)	**1 (4.5 %)**	**6 (18 %)**	**7 (12.9 %)**

p=0.119(NS)

Table 14: Respiratory Problems in Infants of Diabetic Mothers

Category	Types	C X R finding				Total	p-value
		RDS	TTN	Pneumonia	MAS		
DM	Pre-gestational Diabetes (%)	2 (16.7)	1 (8.3)	0 (0)	0 (0)	12 (100)	0.113
	Gestational Diabetes (%)	0 (0)	4 (9.5)	3 (7.1)	1 (2.4)	42 (100)	
	Total (%)	**2 (3.7)**	**5 (9.3)**	**3 (5.6)**	**1 (1.8)**	**54 (100)**	
Glycemic Control	Suboptimal (%)	0 (0)	1 (4.5)	1 (4.5)	1 (4.5)	22 (100)	0.465
	Optimal (%)	2 (6.2)	4 (12.5)	2 (6.2)	0 (0)	32 (100)	
	Total (%)	**2 (3.7)**	**5 (9.3)**	**3 (5.6)**	**1 (1.8)**	**54(100)**	

Table 15: Hairy Pinna in Infants of Diabetic Mothers

Category	Types	Hairy Pinna		Total	p Value
		Present	Absent		
DM	Pre-gestational Diabetes (%)	8(66.7)	4(33.3)	12(100)	p=0.462
	Gestational Diabetes (%)	23 (54.8)	19(45.2)	42(100)	
	Total (%)	**31(57.4)**	**23 (42.6)**	**54(100)**	
Glycemic Control	Optimal (%)	16(72.7)	6(27.3)	22(100)	p=0.059
	Suboptimal (%)	15(46.9)	17(53.1)	32(100)	
	Total (%)	**31(57.4)**	**23 23(42.6)**	**54(100)**	

Table 16: Neonatal Outcome in IDMS

Outcome	Total	Percent
Survival	51	94.5
Death	3	5.5
Total	**54**	**100**

DISCUSSIONS

The IDMs are at an increased risk of complications compared to infants of non diabetic mothers. The causes of the fetal and neonatal squeal of maternal diabetes are likely multi factorial; however, many of the perinatal complications can be traced to the effect of maternal glycemic control on the fetus. Many of the perinatal complications in IDMs can be prevented by appropriate periconceptional and prenatal care [5]

In the present study conducted at SCB MCH, 54 infants born to diabetic mothers formed the study group. 54 infants were born to 54 mothers,12 to pre-gestational diabetic mothers (type I and type II DM) mothers that constituted 22.2 % and 42 to gestational diabetic mothers that constituted 77.8 %,. The incidence of mothers with gestational diabetes was similar to study done by Ranade et al [12] (64 %), Deorari et al (85.5 %) [13], Alam et al [14] (62.5 %), CB Mahmood et al [15] (59.6 %), Prabhavathi et al [16] (87.5 %) and Anjum et al [17] (86 %).

In the present study, 30 IDMs were male and 24 were female which showed a male preponderance. We also observed that 40.7 % of the mothers had optimal glycemic control (HbA1c < 6.5 %) and 59.3 % mothers had suboptimal glycemic control (HbA1c ≥6.5 %). Optimal glycemic control was defined as HbA1c <6.5 % in women with pre-gestational diabetes. The number of mothers with suboptimal control was more in the present study. Among pre-gestational diabetic mothers, 75 % had suboptimal control whereas 54.8 % of gestational diabetic mothers had suboptimal control. 28 of the diabetic mothers were On insulin, 18 were on diet and 8 were on oral medications such as metformin.

Table 17 shows Lower segment cesarean section for IDMs varies from as low as 21 % to as high as 82 % in some. LSCS was done in IDMs, either for maternal or fetal indications. In the present study, 70.4 % DMs were born by LSCS, the incidence of LSCS was higher as compared to NVD, as seen in study done by Ranade et al [12], Deorari et al [13], Alam et al [14] and CB Mahmood et al [15]. The apparently higher rate of LSCS in our study seems to be in accordance with the similar trend noted all over the world in recent years, especially in high risk pregnancies. The relatively less numb high risk vaginal deliveries and no instrumental delivery may be one of the primary contributors toward the less noted incidence of birth trauma or perinatal asphyxia in our study. In few of studies, more number of babies were born out of vaginal delivery, as seen in study done by Watson et al[18], Akhlaghi et al [19], Prabhavathi et al [16] and Anjum et al [14].

Table 18 shows In the present study, the incidence of term IDMs was higher than preterm IDMs which was comparable to the study done by Ranade et al [12], Deorai et al [13], Watson et al [18], Akhlaghi et al [19], Alam et al [14], CB Mahmood et al [15], Prabhavathi et al[16]and Anjum et al [17]. The incidence of prematurity varies from as low as 7.7 % to as high as 46 % in few of the studies.

Table 19 shows The incidence of AGAs, as compared to LGAs is more prevalent in our study, as seen in other study done by Ranade et al[12], Deorari et al [13], Alam et al[14] and Begum et al [20]. The incidence of LGA in IDMs varies from 20 % to 40 % in some. In the present study, the incidence of LGA IDMs was 37 % which is similar to results obtained by Deorari et al [13] and Ranade et al [12]. In the present study, there was significant statistical difference between optimal and suboptimal glycemic control groups with regard to birth weight for gestational age. We didn't encounter any SGA IDM in our study.

Table 20 shows In the present study, hypoglycemia was the commonest problem observed in IDMs which was similar to study done by Ranade et al [12], Deorai et al[13], Alam et al[14], CB Mahmood et al[15], Prabhavathi et al[16]and Anjum et al[17]. The incidence of hypoglycemia varies from 16 % to 54 %. Estimates of the incidence of hypoglycemia in neonates vary with the definition of hypoglycemia used, the population of interest, and neonatal feeding patterns. This may account for wide range seen in various studies. In our study, incidence of hypocalcemia, macrosomia, respiratory distress each was around 37 % which was the second most common complication. The other complications such as hyperbilirubinemia, polycythemia, birth asphyxia, respiratory distress syndrome seen in IDMs are comparable to other studies with some differences. The incidence of congenital anomalies varies from 4 % to 40 %, in our study; we had 13 % IDMs with congenital anomalies. Cardiac anomalies accounted 57.1 % of all congenital anomalies with overall incidence of 7.4 %. Study by Prabhavathi et al [16] showed incidence of 16.6 %, cardiac anomalies constituted 80% all congenital anomalies whereas study done by Anjum et al [17]showed incidence of 40 % and congenital heart diseases accounted for 85 % of all the anomalies. In our study, we have considered babies with birth weight greater than 4000g or birth weight above 90th percentile for gestational age as macrosomic babies [22, 23]. So the incidence of macrosomic babies is around 37 % which is comparable to study done by Ranade et al [12] and Alam et al [14] but is slightly higher as compared to the other studies.

Table 21 shows The incidence of hypoglycemia was higher in both pre-gestational (58.3 %) as well as gestational diabetes (57.1 %) in the present study which is comparable to study done by Deorai et al[13], Akhlaghi et al[19], CB Mahmood et al[15]. The incidence of hypocalcemia, respiratory distress and hyper bilirubinemia is more in pre-gestational diabetes as compared to gestational diabetes. This is comparable to the study done by Deorari et al [13]. The incidence of macrosomia was more in gestational diabetes mellitus which is comparable to study done by Akhlaghi et al [19]. The incidence of polycythemia and birth asphyxia was more in gestational diabetes as seen in study by CB Mahmood et al 63. The incidence of congenital anomalies was more in pre-gestational diabetes mellitus as comparable to study done by Deorari et al [13] and Akhlaghi et al [19].

Table 22 shows The incidence of hypoglycemia, hyperbilrubinemia, macrosomia and polycythemia in our study is more prevalent in suboptimal glycemic group which is comparable to other studies done by Quintero et al [21], Prabhavathi et al[16]and Anjum et al[17]. In our study, the incidence of complications among the two groups was not significant except for hypoglycemia and macrosomia, where there is a significant statistical difference between the two groups.

Table 23 shows the mortality rate in IDMs in the present study was 5.5 % which is comparable to study done by CB Mahmood et al [15] in 2008 but deviates largely from study done by Ranade et al [12] in1989. This may be because of better availability of facilities for neonatal care and monitoring and optimal glycemic control in pregnancy.

Table 17: Comparative Study on Type of Delivery in IDMS

Study Done by	No of IDMS	LSCS	Spontaneous Vaginal Delivery	Instrument Assisted Delivery
Ranade et al[12], 1989	50	58 %	34 %	8 %
Deorari et al[13], 1991	263	56.5 %	40.2 %	3.3 %
Watson et al[18], 2003	136	40 %	60 %	-
Akhlaghi et al[19], 2005	100	43 %	57 %	-
Alam et al [14], 2006	40	55 %	45 %	-
CB Mahmood et al[15],2008	52	82.6 %	17.4 %	-
Prabhavathi et al[16], 2015	120	42 %	58 %	-
Anjum et al [17], 2018	100	21 %	79 %	-
Present study -2019 Cuttack	54	70.4 %	29.6 %	-

Table 18: Comparative Study on Incidence of Prematurity in Various Studies

Study Done By	No of Cases	< 37 Weeks	≥ 37 Weeks
Ranade et al[12], 1989	50	36 %	64 %
Deorari et al[13], 1991	263	16 %	84 %
Watson et al[18], 2003	136	46 %	54 %
Akhlaghi et al[19], 2005	100	13 %	67 %
Alam et al [14],2006	40	12.5 %	87.5 %
CB Mahmood et al[15], 2008	52	7.7 %	92.3 %
Prabhavathi et al[16],2015	120	15 %	85 %
Anjum et al [17], 2018	100	36 %	64 %
Present study Cuttack 2019	54	46.3 %	53.7 %

Table 19: Comparative Study on Incidence of AGA / LGA / SGA IDMS in Various Studies

Study Done By	LGA	AGA	SGA
Ranade et al [12], 1989	40 %	44 %	16 %
Deorari et al [13], 1991	41.5 %	44.3 %	14.2 %
Alam et al [14],2000	45 %	50 %	5 %
Begum et al[20], 2009	20.9 %	79.1 %	-
Present study-2019 Cuttack	37 %	63 %	-

Table 20: Multi-Parameter Comparison Complications Seen In IDMS in Various Studies

Complications	Ranade et al [12], 1989	Deorari etal[13], 1991	Alam et al[14], 2000	CB Mahmood et al[15], 2008	Prabhavathi et al [16], 2015	Anjum et al[17], 2018	Present Study, 2019 Cuttack
Hypoglycemia	50 %	16 %	35 %	23 %	28 %	54 %	57.4 %
Hypocalcemia	14 %	2 %	15 %	19.2 %	12.5 %	43 %	37 %
Respiratory Distress	-	8 %	-	-	-	-	37 %
RespiratoryDistress Syndrome	14 %	3.8 %	-	3.8 %	8 %	16 %	3.7 %
Macrosmia	40 %	20.2 %	45 %	22.4 %	20 %	15 %	37 %
Hyperbilirubinemia	8 %	8 %	30 %	-	18 %	42 %	35.2 %
Polycythemia	20 %	2 %	-	19.2 %	27.8%	35 %	27.8 %
Birth Asphyxia	18 %	9 %	15 %	23 %	-	-	18.5 %
Congenital Anomalies	4 %	4 %	25 %	5.7 %	16.6 %	40 %	13 %
Birth Injuries	-	-	-	1.9 %	-	-	1.9 %

Table 21: Comparison of Neonatal Morbidity in Pre-Gestational and Gestational Diabetes in Various Studies

Complications	Deorari et al[13], 1991		Akhlaghi et al[19], 2005		CB Mahmood et al[15], 2010		Present study 2019 Cuttack	
	PGDM	GDM	PGDM	GDM	PGDM	GDM	PGDM	GDM
Hypoglycemia	21 %	16 %	21.9 %	18.5 %	38.09 %	12.9 %	58.3 %	57.1 %
Hypocalcemia	13 %	-	-	-	23.8 %	16.1 %	41.7 %	35.7 %
Respiratory Distress	11 %	8 %	-	-	-	-	58.3 %	31 %
Respiratory Distress Syndrome	5.3 %	3.6 %	13.6 %	3.7 %	-	-	16.7 %	-
Macrosomia	-	-	6.8 %	14.8 %	-	-	25 %	40.5 %
Hyperbilirubinemia	11 %	8 %	-	-	-	-	50 %	30.9 %
Polycythemia	11 %		-	-	-	25.8 %	25 %	28.6 %
Birth Asphyxia	18 %	8 %	-	-	9.5 %	25.8 %	16.7 %	19 %
Congenital Anomalies	5 %	4%	12.3 %	3.7 %	-	-	25 %	9.5 %
Birth Injuries	-	-	-	-	-	-	8.3 %	-

Table 22: Comparison of Neonatal Complications in Infants of Mothers with Optimal and Suboptimal Glycemic Control with Other Studies

Complications	Quintero et al[21], 2007		Prabhavati et al[16], 2015		Anjum et al[17], 2018		Present study 2019 Cuttack	
	Optimal	Sub optimal	Optimal	Sub optimal	Optimal	Sub optimal	Optimal	Sub optimal
Hypoglycemia	7.1 %	9.3 %	12 %	63 %	18 %	36 %	22.7 %	81.2 %
Hyperbilirubinemia	8.4 %	10.1 %	-	-	-	-	31.8 %	37.5 %
Macrosomia	3 %	15.7 %	5 %	52 %	5 %	10 %	9.1 %	56.2 %
Polycythemia	-	-	2.4 %	16 %	10 %	25 %	27.2 %	28.1 %

Table 23: Perinatal Outcome in IDMS in Various Studies

Study Done By	Mortality
Ranade et al[12], 1989	20 %
Deorari et al[13], 1991	3 %
CB Mahmood et al[15], 2008	5.7 %
Present study, Cuttack 2019	5.5 %

SUMMARY

The present study was conducted in SCB Medical College & Hospital and SVPPGIP Cuttack, and the study included all singleton live born infants of diabetic mothers.

Out of 54 infants included in the study, 30 (55.6 %) were males and 24 (44.4 %) were females. 22.2 % of the mothers had pre-gestational diabetes mellitus and 77.8 % of the mothers had gestational diabetes. 40.7 % of the mothers had optimal glycemic control which was defined as HbA1c < 6.5 % and 59.3 % of the mothers had suboptimal glycemic control which was defined as HbA1c≥6.5 %. 51.9 % of the mothers had received insulin during pregnancy, 33.3 % were on diet and 14.8 % were on oral medications. 46.3 % of the IDMs were born prematurely and 53.7 % were born after 37 completed weeks of gestation. Mean gestational age was 35.98±3.32 weeks in the present study. 11(20.4 %) IDMs were low birth weight and 12 (22.2 %) IDMs weighed ≥4kgs at birth in the present study. Mean birth weight was 3030 ± 970gm. LGA IDMs constituted 37 % of the study, rest 63 % IDMs were AGA. We didn't encounter any SGA IDM in our study. Significant statistical difference was obtained when we compared to birth weight for gestational age of IDMs with glycemic control in the mother. Hypoglycemia was the

commonest complication observed in 57.4 % IDMs followed by respiratory distress, macrosomia and hypocalcemia, each constituting 37 %. Birth injury in the form of Erb's palsy was the least common complication accounting for 1.9 %. There was no significant statistical difference in the complications seen in the infants born to mothers with pre-gestational and gestational diabetes. However, there was significant relationship between some complications such as hypoglycemia and macrosomia seen in IDMs with maternal glycemic control. There was no significant difference in congenital anomalies observed in IDMs born to pre-gestational and gestational diabetic mothers. There was no significant difference in congenital anomalies observed in IDMs born to optimal and suboptimal glycemic control mothers. Hyoglycemia was common in IDMs who weighed > 4kg at birth (75 %). It was found that hypoglycemia was common in IDMs at less than 6 hours of post natal age (40.7 %). The incidence of respiratory complications was more in IDMs born to mothers with suboptimal glycemic control 25 %, whereas it was 13.6% in optimal glycemic control group. RDS was only seen in 2(6.2%) infants born to mother with suboptimal glycemic control. Incidence of pneumonia (6.2 %) and TTN (12.5 %) was more in infant of diabetic mother born to suboptimal glycemic control group as compared to infant of diabetic mother born to optimal glycemic control group. Hairy pinna was observed in 57.4 % infant of diabetic mother. Congenital anomalies were present in 13 % of infant of diabetic mother, out of which 57.1 % had cardiac anomalies. Overall, incidence of cardiac anomalies was 7.4 %; 1 case each of PDA, ASD, VSD and MR with cleft mitral valve was observed. 1IDM with Hydroureteronephrosis, 1 IDM with cleft lip and 1 IDM with CTEV was noted in our study. Out of 54 infant of diabetic mother, 11(20 %) required NICU admission. In the present study, 51(94.5 %) IDMs survived and mortality was around 5.5 %. Three IDMs had died in our study. 2 died due to birth asphyxia (1died at 60 hrs and other died at 48 hrs) and the 3rd IDM died due to prematurity with sepsis at 72 hours of life.

CONCLUSIONS

The neonatal complications commonly seen in infants of diabetic are hypoglycemia, respiratory distress, hyperbilirubinemia, birth asphyxia, macrosomia, polycythemia, hypocalcemia, congenital anomalies and RDS. This has been reaffirmed in the present study.

There is no significant difference in neonatal morbidity profile of infants born to pre-gestational and gestational diabetic mothers.

There is significant statistical association between glycemic control and Hypoglycemia and macrosomia in infants of diabetic mother.

Poor metabolic control is associated with metabolic derangement in the neonatal period. HbA1c is of value in identifying pregnant diabetics at special risk.

As neonatal complications are more common in women with suboptimal glycemic control, management goals in pregnancies complicated by Diabetes Mellitus should be to achieve optimal glycemic control.

With appropriate care and management of diabetes during pregnancy, the perinatal outcome of infants of diabetic mother can be improved.

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