

A STUDY OF NEONATAL OUTCOME IN INFANTS OF DIABETIC MOTHERS ADMITTED IN NICU OF TERTIARY CARE HOSPITAL

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Abstract

Back ground: Infants who are born to Diabetic mothers have been found to be at a significantly increased risk for perinatal morbidity and mortality risks. The improvement of the outcome of diabetes pregnancies through the use of appropriate maternal glycaemic control has been a goal for doctors.

Materials and Methods:

Prospective observational study was conducted in Department Of Pediatrics, Kurnool Medical College and Government General Hospital from January 2021 – December 2022. The data of IDMs were collected from postnatal ward. All IDMs delivered during this period staying in postnatal ward were included in this study. The outcomes were compared between the hypoglycaemic and normoglycemic IDMs and between gestational diabetes mellitus (GDM) and pre-GDM in hypoglycaemic group using Chi-square test and Fisher's exact test. The data analysis was performed with Epi-info7 software. Statistical significance was set at $P < 0.05$.

Results:

Out of 100, 16.25% had birth weight more than 4 Kg, 60% had hypoglycaemia. 23.75% of neonates are Large for gestational age, 45% developed hypocalcaemia and 43% developed hyperbilirubinemia. 62% had polycythaemia, congenital anomalies in 15%, 8.75% had birth injuries, incidence of mortality was 10%.

Conclusion: GDM and ODM are common metabolic disorders in pregnancy which cause variety of neonatal complications .All pregnant mothers must undergo diabetes screening. They need better glycaemic management and regular follow-up. Delivery should be planned in order to decrease the risk of shoulder dystocia and birth injuries, and the rate of emergency caesarean sections. To enhance newborn outcomes, all babies born to mothers with diabetes should be admitted to the neonatal care unit for observation. Need special attention to mothers for GDM prevention and DM therapy.

Key words: Gestational diabetes mellitus, hypoglycaemia, infants of diabetic mother

INTRODUCTION

Diabetes Mellitus refers to a group of common metabolic disorders that share the common phenotype of hyperglycemia. It is the most common medical complication during pregnancy which affects about 0.5% to 5% of all pregnancies. It may be before pregnancy (pre-gestational or overt diabetes) or may be detected for the first time during pregnancy (gestational diabetes). Of these 80% are caused by gestational diabetes mellitus. Gestational diabetes (GDM) is defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy.¹ GDM increases the risk of complications via a myriad of

biological mechanisms. Overt maternal diabetes mellitus can adversely influence intrauterine development. Infants born to diabetic mother (IDM) are at increased risk of complications which may be periconceptional, fetal, neonatal and even long term. Spontaneous abortions and congenital anomalies may be induced in the first trimester. Excessive foetal growth, neonatal hypoglycemia, jaundice, Polycythemia and stillbirth may be induced during the second and third trimesters. These infants of diabetic mothers are at higher risk of complications and congenital anomalies like Macrosomia, hypoglycemia, hypocalcaemia, hypomagnesaemia, Polycythemia, Hyperbilirubinemia, prematurity, transient tachypnea of new born, respiratory distress syndrome, birth asphyxia, congenital heart diseases like interventricular septal Hypertrophy, transient hypertrophic sub aortic stenosis, cardiomyopathy, cleft lip, cleft palate, sacral agenesis, jitteriness, seizures, movement disorders. A strong association between congenital anomalies and maternal glycemic control has been documented.²

The number of patients with diabetes mellitus has been steadily increasing worldwide and diabetes mellitus has become a global health problem. This tendency is also observed in women of child-bearing age partly due to the change in diagnostic criteria of gestational diabetes mellitus (GDM) as mentioned later. The prevalence of diabetes is increasing globally and India is no exception. The 1997 WHO estimates of the prevalence of diabetes in adults showed an expected total rise of > 120% from 135 million in 1995 to 300 million in 2025. These numbers also include GDM and should alert physicians to the need to direct special attention to this population, especially in developing countries. Between 3 and 5 % of all pregnant women show glucose intolerance. Approximately 90% of these women have gestational diabetes³. By detecting abnormal maternal glucose metabolism at an early stage of pregnancy and achieving excellent glycemic control during pregnancy, it is possible to prevent perinatal maternal-infant complications. According to a report on a meta-analysis of 20 studies, the relative risk for patients with GDM of developing type 2 diabetes mellitus after delivery is 7.43 times higher than that of women who had normal glucose tolerance during pregnancy. Therefore, it is important to follow up mothers after delivery. Moreover, the concept of developmental origins of health and diseases was proposed recently and the long-term effects of mothers with abnormal glucose tolerance on foetuses after birth have been actively discussed. Thus, it is important to manage glycemic control of mothers appropriately not only because it helps to maintain the health of mothers and infants in the short term, but also helps to maintain the long-term health of mothers and the next generation.⁴

Data from high-income nations show that 5% to 7% of pregnancies are complicated by GDM. GDM is a worldwide health issue that affects up to 5 million women annually in India.⁵ According to recent studies, the prevalence of GD has risen over the past ten years, and rates may be higher in particular racial or ethnic communities. The mother and foetus both run the risk of GDM. Unfavorable foetal outcomes and an increased risk of obstetrical problems are linked to GDM. Preeclampsia, Caesarean sections, stillbirths, macrosomia, and hypoglycemia are a few of them. Additionally, a history of GDM is linked to an increased risk of GD in subsequent pregnancies, type 2 diabetes, and cardiovascular disease in later life.⁶ There is wide variability in reported prevalence estimates for GDM in India, varying from less than 4% to nearly 18%.⁷ Despite a government requirement to screen all expectant women for GDM, screening programmes have only been partially implemented and adopted up to this point. There are currently only single-center studies on GDM in India, the majority of which are carried out in hospital-based urban populations. National statistics on the prevalence of type 2 diabetes in the Indian population are beginning to emerge.⁸ The prevalence is roughly 7% overall, higher in urban than rural areas, more prevalent in older age groups, and more prevalent

in groups with higher socioeconomic status (SES): Concern exists over an anticipated increase in the prevalence of diabetes and a corresponding rise in GD.⁹

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. Abnormalities of carbohydrate metabolism occur frequently during pregnancy and studying clinical profile of the patients presenting in the outpatient and inpatients department, in this Tertiary care hospital by different investigating modalities helps to arrive at diagnosis and will further aids in earlier case detection and therapeutic outcome.. Due to increased perinatal morbidity and mortality, IDM babies should be closely monitored.

Studies have shown that strict control of maternal glucose during pregnancy has a favourable perinatal outcome.¹⁰ so, present study is done to evaluate neonatal outcome in infants of diabetic mothers admitted in NICU of our tertiary care hospital.

AIMS AND OBJECTIVES

AIM: To study the various complications, adverse outcome and factors influencing severity of outcome in infants of diabetic mothers

OBJECTIVES: To study the various metabolic and haematological abnormalities in neonates of diabetic mothers,

To know incidence of infants of diabetic mothers requiring hospital admission

To study the incidence and patterns of congenital anomalies in infants of diabetic mothers

To study and compare the outcome in infants of GDM mothers and overt DM mothers.

PATIENTS AND METHODS

TYPE OF STUDY – Prospective observational Study

DURATION – 2 years (January 2021 – December 2022)

PLACE OF STUDY – Department. Of Paediatrics, Kurnool Medical College and associated hospital, Kurnool.

INCLUSION CRITERIA

All singleton neonates of diabetic mothers

EXCLUSION CRITERIA

Multiple pregnancy

Mothers with other risk factors like:

PIH

Heart disease

APH

Renal disease

Hepatic disease

Chronic lung disease

SAMPLE SIZE – 100

It is estimated based on the study done by Puneesh Agarwal et al¹¹ titled “Study of neonatal outcome in infants born to mothers with Gestational Diabetes in North Indian Population – A cross-sectional study.” A total of 130 mothers/babies were included in the study. Based on, frequency of complication hypoglycemia in above study = 25.4%

Using the variables, Population size = 130

Hypothesized % frequency of a factor in population = 25.4% Confidence level – 95%

Design effect for a random sample - 1 Sample size $n = [DEFF * Np (1-p)] / [(d2/Z2*(N-1) + p*(1-p)]$

Required sample size is 93. So, a total of 100 study subjects are enrolled in study.

METHODOLOGY

Neonates of mothers who are diagnosed to have gestational DM or overt DM admitted at government general hospital Kurnool, who fulfilled the above mentioned criteria were included in this study

Institutional review board approval was obtained for this study.

Thorough history of diabetic mothers was taken and data regarding age, onset of DM, parity, gestational age, diabetic control, history of previous abortions & stillbirths, mode of delivery was collected.

Diabetic mothers with blood glucose levels 70 – 110mg/dl throughout the day considered as good glycaemic control & above this levels as poor glycaemic control.

Macrosomia is defined as weight more than 90th percentile (large for gestational age, LGA), foetal growth restriction as birth weight less than the 10th percentile (small for gestational age, SGA).

Hypoglycaemia as blood glucose levels less than 40 mg/dl, hypocalcaemia as serum calcium level less than 7 mg/dl. Polycythaemia as haematocrit higher than 65%. Major congenital anomaly is defined as one which is any of the following; lethal, life- threatening, requires major surgery or affecting life significantly.

On basis of Apgar score, new-born assessment is done to determine the need for any resuscitative efforts. Baby weighed and gestation is assessed.

All neonates who were born to diabetic mothers are clinically examined for congenital anomalies.

Other biochemical and haematological parameters were collected as follows .Blood glucose levels checked at 1,2,3,6,12,24,36 & 48 hours by glucostix. Serum calcium levels measured at 24 hours of age, later if baby remains symptomatic or hypocalcaemia. Complete hemogram was done at 24 hours.

Blood samples collected in each time in all cases by a trained technician, results were measured by autoanalyzer. Echocardiography and ultrasound abdomen was done routinely for all the infants. Among other investigations: chest x ray posterior-anterior view (CXR PA), plain X ray of lumbosacral spine, were done as indicated by clinical parameters.

We studied the birth weight, gender of the baby, birth injuries, mode of delivery and preterm birth. The entire data was recorded in individual patient's proforma.

The results were statistically analysed.

STATISTICAL METHODS

The data analysis was performed with Epi-info7 software. Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean \pm SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Chi- square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Diabetic status	Glycemic control		
	GDM(n=80)	Overt DM(n=20)	
MOD Normal	15(18.75%)	10(50%)	0.005*
Assisted vaginal	07(8.75%)	03(15%)	
LSCS	58(72.5%)	07(35%)	
Gender Male	60(75.00%)	12(60.00%)	0.18
Female	20(25.00%)	08(40.00%)	
Birth weight 2 - 2.49	05(6.25%)	11(55.00%)	0.04*
2.5 - 2.9	12(15.00%)	07(35.00%)	
3 - 3.4	21(26.25%)	01(5.00%)	
3.5 - 3.9	29(36.25%)	01(5.00%)	
≥4	13(16.25%)	00(0.00%)	
Gestational age SGA	03(3.75%)	04(20.00%)	0.02*
AGA	58(72.5%)	14(70.00%)	
LGA	19(23.75%)	02(10.00%)	
Complications	48(60.00%)	05(25.00%)	0.03*
Hypoglycemia			
Hypocalcemia	36(45.00%)	04(20.00%)	0.02*
Polycythemia	49(62%)	34(43%)	0.03*
Hyperbilirubinemia	07(35%)	05(25%)	0.04*
CVS Anomalies	08(10.00%)	03(15.00%)	0.83
CNS Anomalies	00(0.00%)	01(5.00%)	0.51
Renal system Anomalies	00(0.00%)	01(5.00%)	0.46
Birth injuries	07(8.75%)	00(0.00%)	0.17
Mortality	02(2.5%)	02(10.00%)	0.12

Table No 1: Neonatal characteristics based on the type of diabetes mellitus of the mother using the chi-square test for nominal and categorical variables and the t-test to compare mean values.

Majority were males, 75% in gestational diabetes mellitus (GDM) and 60% in overt diabetes mellitus but it is not statistically significant.

Birth weight less than 4kg was present among 83.7% of the neonates in gestational diabetes mellitus (GDM) while all the neonates born to overt diabetes mellitus mothers have birth weight less than 4kg. Birth weight ≥ 4 kg was present among 16.25% of the neonates born to gestational diabetes mellitus (GDM) mothers while none of the neonates born to overt diabetes mellitus mothers had birth weight ≥ 4 kg and this difference is statistically significant.

Majority of the infants born to diabetic mothers (IDM) are appropriate for gestational age in both gestational diabetes mellitus (GDM) and overt diabetes mellitus. Large for gestational age were present among 23.75% of neonates in gestational diabetes mellitus (GDM) compared to 10% of neonates in overt diabetes mellitus and this difference is statistically significant. hypoglycemia was found in 60% of infants born to GDM mothers compared to 25% infants born to Overt DM mothers. Further, it was observed that hypoglycemia is significantly associated with diabetic status of

mothers. Hypocalcemia was seen in 45% infants born to GDM mothers compared to 20% infants born to Overt DM mothers and it is statistically significant.

49(62%) of the neonates born to gestational diabetes mellitus (GDM) mothers had polycythemia compared to 07(35%) of the neonates born to overt diabetes mellitus mothers and it is statistically significant. 34(43%) of the neonates born to gestational diabetes mellitus (GDM) mothers had hyperbilirubinemia compared to 05(25%) of the neonates born to overt diabetes mellitus mothers and it is also statistically significant. One infant born to GDM mother died within 6hrs of life, hence not evaluated for hematological abnormalities. Majority of neonates born to both Gestational diabetes mellitus mothers 08(10%) and overt diabetes mellitus mothers 03(15%) had congenital anomalies of cardiovascular system. Central nervous system (5%) and renal system congenital anomalies (5%) one in each occurred among infants of overt diabetic mothers. Further, it was observed that there was no association between occurrence of congenital anomalies and diabetic status of mothers. 8.75% of the neonates born to gestational diabetes mellitus (GDM) mothers had birth injuries while none of the neonates born to overt diabetes mellitus had birth injuries but it is statistically not significant. incidence of mortality was 10% in infants born to overt diabetes mellitus mothers compared to 2.5% in infants born to gestational diabetes mellitus mothers but it is not statistically significant.

DISCUSSION

Neonatal hypoglycemia occurs in IDMs with impaired gluconeogenesis, brought about by excess insulin production, an inadequate substrate supply, decreased glucagon, and catecholamine secretion, which suggests altered counter-regulatory hormone production.¹²

Pedersen's hypothesis states that maternal hyperglycemia leads to fetal hyperglycemia, which leads to overstimulation of the islet cells of the fetal pancreas and to secondary fetal hyperinsulinism. So the IDMs are at significant risk for the development of hypoglycaemia.¹³

Neonates born to diabetes mothers (IDM) are more likely to experience periconceptual, foetal, neonatal, and even long-term problems. Through a variety of biological pathways, GDM raises the risk of problems. Intrauterine development may be negatively impacted by overt maternal diabetes mellitus. Congenital abnormalities and spontaneous abortions can both be induced during the first trimester.

The second and third trimesters can cause excessive foetal growth, newborn hypoglycemia, jaundice, polycythemia, and stillbirth.¹⁴

Neonates whose mothers have diabetes are more likely to experience complications and congenital anomalies such as macrosomia, hypoglycemia, hypocalcemia, hypomagnesemia, polycythemia, hyperbilirubinemia, prematurity, transient tachypnea of the newborn, respiratory distress syndrome, and birth asphyxia, as well as congenital heart diseases such as Ventricular septal defect, interventricular septal hypertrophy, transient hypertrophic subaortic stenosis.¹⁴

Maternal glycemic control and congenital abnormalities have been shown to be strongly correlated.¹ Although better metabolic control before and during pregnancy and better newborn care have significantly improved the prognosis of diabetic pregnancies in affluent nations, managing diabetes in underdeveloped countries remains a substantial problem. IDM newborns should be properly watched because perinatal morbidity and mortality have increased.¹⁵

Based on the observations of the present study, Majority were males, 75% in gestational diabetes mellitus (GDM) and 60% in overt diabetes mellitus but it is not statistically significant.

Birth weight less than 4kg was present among 83.7% of the neonates in gestational diabetes mellitus (GDM) while all the neonates born to overt diabetes mellitus mothers have birth weight less than 4kg. Birth weight ≥ 4 kg was present among 16.25% of the neonates born to gestational diabetes

mellitus (GDM) mothers while none of the neonates born to overt diabetes mellitus mothers had birth weight ≥ 4 kg and this difference is statistically significant. . Our findings were similar to the findings in a Basavarajaiah et al, Imdad et al, Salima A,^{16,17,18}

Majority of the infants born to diabetic mothers (IDM) are appropriate for gestational age in both gestational diabetes mellitus (GDM) and overt diabetes mellitus. Large for gestational age were present among 23.75% of neonates in gestational diabetes mellitus (GDM) compared to 10% of neonates in overt diabetes mellitus and this difference is statistically significant.

Our study findings are supported by Chirag Shah et al¹⁹, here AGA was 57.5 % and LGA was 22.5%. This findings are similar to other studies .^{16,17,18}

Hypoglycemia was found in 60% of infants born to GDM mothers compared to 25% infants born to Overt DM mothers. Further, it was observed that hypoglycemia is significantly associated with diabetic status of mothers. Hypocalcemia was seen in 45% infants born to GDM mothers compared to 20% infants born to Overt DM mothers and it is statistically significant. This may be due to the fact that mothers with Overt DM had good glycemic control as they were diagnosed before pregnancy and were advised regarding the complications during pregnancy which probably prevent fetal hyperinsulinism and significant hypoglycemia.¹⁹ Our study findings were supported by all other studies.^{16,17,18}

49(62%) of the neonates born to gestational diabetes mellitus (GDM) mothers had polycythemia compared to 07(35%) of the neonates born to overt diabetes mellitus mothers and it is statistically significant. 34(43%) of the neonates born to gestational diabetes mellitus (GDM) mothers had hyperbilirubinemia compared to 05(25%) of the neonates born to overt diabetes mellitus mothers and it is also statistically significant. Similarly, in a study by Basavarajaiah et al.¹⁶

One infant born to GDM mother died within 6hrs of life, hence not evaluated for hematological abnormalities.

Majority of neonates born to both Gestational diabetes mellitus mothers 08(10%) and overt diabetes mellitus mothers 03(15%) had congenital anomalies of cardiovascular system. Central nervous system (5%) and renal system congenital anomalies (5%) one in each occurred among infants of overt diabetic mothers. Further, it was observed that there was no association between occurrence of congenital anomalies and diabetic status of mothers. Similarly, in a study by Basavarajaiah et al.¹⁶ The most common congenital anomaly in neonates was recorded, the cardiovascular abnormalities found to be common and were total 30(91%), of them 19(73.07%) cases were found in overt DM mother. And also in a study by Bayoumi et al, Major congenital malformations were found in 0.6% of neonates born to GDM women, compared to 0.8% in healthy controls and 2% in women with pre-pregnancy DM. The literature has reported that the overall reported risk for major malformations is approximately 5 to 6 percent with a higher prevalence rate of 10 to 12 percent when mothers require insulin therapy]. Out of the 41 cases of major congenital anomalies in their study, 29 involved the cardiovascular and central nervous systems¹⁷

8.75% of the neonates born to gestational diabetes mellitus (GDM) mothers had birth injuries while none of the neonates born to overt diabetes mellitus had birth injuries but it is statistically not significant. Similar study was done by Basavarajaiah et al.¹⁶ And also, in a study by Imdad et al, 25% of neonates were macrosomic and have their weight more than 4 Kg. Out of these one have fracture femur and one Erb's Palsy, two have haematoma and bruises. One of them have incisional cut on scalp.¹⁸

Macrosomia, shoulder dystocia, & Maternal obesity which is especially associated with gestational diabetes mellitus (GDM) and type 2 diabetes (T2D), are the risk factors for birth-related injuries. Since the incidence of birth injuries is low and a remarkable number of cases in the general population are unpredictable, it is important to explore the risk factors and incidences associated with high-risk pregnancies.¹⁹

incidence of mortality was 10% in infants born to overt diabetes mellitus mothers compared to 2.5% in infants born to gestational diabetes mellitus mothers but it is no statistically significant.

Similarly in Basavarajaiah et al study, the total mortality of (3%) was seen in both the population (GDM and overt), a total of 2(7.7%) cases found in over GDM mortality²⁰

Also in a study by Imdad et al, it is observed that 20 % infants are asymptomatic and 80% are symptomatic and sick neonates .3 infants out of these 80% sick infants expired. Mortality rate in their study became 3.7% and morbidity was 15%.¹⁸

Early detection and appropriate management of diabetes complicating pregnancy have been associated with lower infant morbidity and mortality thus resulting in a healthy perinatal outcome, according to studies. In view of this current study is carried out to evaluate the complications and to study the outcome of babies born to diabetic mothers admitted in NICU of Tertiary Care Centre.

CONCLUSION

GDM and ODM are common metabolic disorders in pregnancy which cause variety of neonatal complications. Maternal diabetic control was found to be an important factor that affects the outcome in IDMs. All mothers should be screened during pregnancy for diabetes. They should have regular follow up and better control for their glucose levels. This can only be achieved by combined clinics between the obstetrician and the endocrinologist. Delivery should be planned in order to decrease the risk of shoulder dystocia and birth injuries, and the rate of emergency caesarean sections. All babies born to mothers with diabetes should be admitted to the neonatal care unit for a period of observation to improve the neonatal outcome. Special care of mother in prevention of GDM, in treatment of DM is to be done.

Neonates born to DM mothers are at risk of variety of complications which need careful monitoring keeping in mind the most devastating hypoglycaemia. Congenital anomalies are also well know and infants need to be immediately given expert care for them. Rapid development of techniques allowing early and accurate pre-natal diagnosis of foetal disorder reduces the rate of congenital anomaly among new-born babies. Antenatal diagnosis of some cardiac conditions decreases the risk of neonatal mortality. This is a hospital based prospective observational study conducted in Department of Paediatrics, Kurnool Medical College and associated hospital, Kurnool to understand the Complications and to study the Outcome of babies born to diabetic mothers admitted in NICU of our Hospital.

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