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Original Research Article

Neonatal outcome in pregnancies complicated by gestational diabetes mellitus: a hospital-based study

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is amongst the most common medical complications of pregnancy associated with adverse maternal and perinatal outcomes. The prevalence of GDM is increasing worldwide especially in India with increasing obesity and lifestyle and dietary changes. Hence this study was undertaken to study the prevalence of GDM and to evaluate its neonatal outcomes.
Methods: This was a prospective study. During the study period, 205 pregnant women between 24 to 28 weeks of gestation were screened for GDM using 75 g oral glucose tolerance test (OGTT) and were diagnosed to have GDM based on WHO criteria. Risk factors for GDM, maternal and neonatal outcomes were studied.
Results: The prevalence of GDM in the study population was 7.8%. Prevalence of GDM cases was significantly associated with body mass index (BMI) >25 kg/m^2, family history of diabetes, previous macrosomia/large for gestational age (LGA) baby and past history of GDM with p <0.001 and with multiparity (p = 0.024). Maternal age >25 years was not statistically associated with prevalence of GDM (p = 0.358). Incidence of pre-eclampsia and polyhydramnios were significantly higher among GDM cases. Operative delivery and assisted (forceps) delivery had strongly significant association with GDM (p <0.001). GDM cases were significantly associated with higher birth weight (>3.5 kg) in the neonates (p <0.001). Hypoglycemia was the most common complication noted in neonates of GDM women. Incidence of respiratory distress, transient tachypnea of the newborn (TTN), polycythemia and neonatal hyperbilirubinemia were also significantly more common among neonates born to GDM women.
Conclusions: BMI >25 kg/m^2, family history of diabetes, past GDM and previous LGA baby were important risk factors for GDM. The study emphasizes the need to screen all pregnant women for GDM, so that timely diagnosis and intervention will reduce both maternal and perinatal complications.

Keywords: 75 g Oral glucose tolerance test, BMI, Gestational diabetes mellitus, Hypoglycaemia, Pre-eclampsia, WHO

INTRODUCTION

Gestational diabetes mellitus (GDM) is amongst the most common medical complications of pregnancy. GDM is defined as carbohydrate intolerance with onset or recognition during pregnancy.[1] It accounts for ~90% of all pregnancies complicated by diabetes.[1] GDM is associated with adverse outcome for the fetus and newborn (macrosomia, birth injuries, shoulder dystocia, respiratory distress syndrome, hypoglycemia, hyperbilirubinemia and childhood obesity). There is increased risk of gestational hypertension, preeclampsia, and operative delivery and their associated potential morbidities in women with GDM.[1] More importantly, there is increased risk of developing type 2 diabetes mellitus (DM) in women diagnosed to have GDM with

approximately 15% to 60% of them developing type 2 DM within 5 to 15 years of delivery.[2]

The prevalence of GDM varies significantly among different ethnicities, populations and with the diagnostic criteria used. Approximately 7% of all pregnancies in the United States are complicated by GDM, accounting for >200,000 cases per year.[3] With the increase in obesity and sedentary lifestyle, the prevalence of GDM is increasing globally and more so in developing countries.

In India, the prevalence of GDM is high and varies with geographical areas and diagnostic methods employed. The prevalence of GDM ranged from 3.8 to 21% in different parts of the India.[4] There is an increase in GDM prevalence in all race/ethnicity as shown by studies conducted in different populations and with different methodologies. An increase in the prevalence of GDM aside from its adverse maternal and neonatal consequences, might reflect or contribute to the ongoing pattern of increasing DM and obesity.[5] Universal screening for GDM identifies more cases and improves maternal and neonatal outcome.[6] Hence universal screening for GDM is essential, as women of Asian origin and especially ethnic Indians, are at a greater risk of developing GDM and subsequent type 2 DM.[1,7] For this, we need a simple procedure which is both feasible and economical. The one step World Health Organization (WHO) procedure using 75 g oral glucose tolerance test (OGTT) to diagnose GDM serves both as a screening and a diagnostic modality at the same time.

The Australian Carbohydrate Intolerance Study in Pregnant Women (ACHOIS) Trial Group using WHO criteria conducted a randomized clinical trial (RCT) to determine whether treatment of women with GDM decreased the risk of perinatal complications and to evaluate the benefits of treatment on maternal outcome, mood, and health-related quality of life. The results of this landmark study of Crowther et al published in 2005 demonstrated significantly lower serious perinatal outcomes in a treated GDM group when compared with an untreated group (1% versus 4%, p= 0.01). The study was conducted as a multicentre, cross-country, RCT, enrolling 1000 women over a 10-year period. Despite the relatively low risk profile of ACHOIS participants, benefits of treatment were convincing.[8]

The aim of the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study was to ascertain associations of maternal glucose levels lower than those diagnostics of overt diabetes during pregnancy with perinatal outcome. The study was done on a heterogeneous, ethnically diverse, multicultural, multinational cohort of ~25,000 women in the third trimester of gestation by performing a 75-g OGTT.[10]

Hence, this hospital-based study was undertaken to evaluate the prevalence of GDM using WHO criterion and to determine the maternal and neonatal outcome.

METHODS

This is a prospective hospital-based study conducted in Sree Mookambika Institute of Medical Sciences (SMIMS), Kulashekaram, a rural area, for a period of one year from January to December 2013, in pregnant women attending OPD of Obstetrics and Gynaecology Department. A total of 205 pregnant women attending the antenatal OPD during the study period with gestational age between 24-28 weeks were enrolled in the study after obtaining consent. Inclusion criteria were pregnant women attending antenatal OPD with gestational age between 24-28 weeks. Pregnant women diagnosed with diabetes prior to pregnancy i.e. overt/pre-gestational diabetes were excluded from the study.

Relevant data as per the pro forma was collected. Risk factors for GDM in all pregnant women (age, BMI, family history, parity, past obstetric history (unexplained fetal loss/neonatal death, still birth, preterm delivery, polyhydramnios, previous pregnancy with GDM), previous large for gestational age (LGA) infant/macrosomia) were noted. All pregnant women underwent detailed clinical examination as per pro forma, irrespective of presence or absence of risk factors.

75 g oral glucose tolerance test (OGTT) was performed between 24-28 weeks of gestation. World Health Organization (WHO) criterion with a threshold plasma glucose concentration of ≥140 mg/dl at 2 hours was used to diagnose Gestational diabetes mellitus (GDM).

The pregnant woman was asked to come to OPD after overnight fasting of at least 8 hours. Fasting plasma glucose was estimated by drawing 2 ml of venous blood. 75 grams of glucose was dissolved in 300 ml of water and the patient was asked to drink it over a five-minute period. After 2 hours of ingestion of glucose, 2 ml venous blood was drawn, and 2-hour plasma glucose level was estimated. The plasma glucose was estimated by glucose oxidation and peroxidation (GOD-POD) colorimetric enzymatic method by using Gesan glucose monoreagent kit.[9]

Those diagnosed as GDM were admitted, evaluated, treated and regularly followed up till they delivered and got discharged from the hospital. Diet therapy was started initially and need for insulin therapy was individualized depending upon the blood glucose level and the glycemic control in each of them.

Maternal complications during the course of pregnancy were noted and managed accordingly. Timing and mode of delivery were planned as per the standard protocols.

All other pregnant women who did not have GDM were also followed up regularly during the antenatal period until they delivered and pregnancy complications if any were managed accordingly.

Birth weight, Apgar scores and need for neonatal resuscitation were recorded at the time of delivery. Gestational age assessed by new Ballard score. Presence of any congenital malformation was documented. Neonates born to GDM mothers were monitored and any neonatal complications during the postnatal period were documented. Neonatal hypoglycemia was defined as blood glucose <40 mg/dl.

Neonatal blood glucose levels were monitored as per protocol and managed accordingly. Presence of metabolic and electrolyte disturbances, respiratory distress/ transient tachypnea of the newborn, neonatal hyperbilirubinemia and other complications were noted in the pro forma.

Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. The following assumptions on data is made:

- Dependent variables should be normally distributed
- Samples drawn from the population should be random, cases of the samples should be independent.

Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

A total of 205 pregnant women attending OPD of Obstetrics and Gynaecology Department, were evaluated for GDM and its maternal and perinatal outcomes. The mean age of patients was 25.60±3.52 years Table 1 presents the demographic and clinical characteristics of the study population. The mean BMI was 22.55 kg/m^2.

54.6% of the pregnant women were multigravida. 21 (10.2%) pregnant women in the study population had family history of diabetes mellitus. 4 (2%) pregnant women had LGA baby in the previous pregnancy out of which 2 of them had GDM in the previous pregnancy. Out of 205 cases, 39 (19.1%) pregnant women had obstetric complication during pregnancy. The prevalence of GDM in the study population is 7.8%.

The mean fasting plasma glucose level (FPG) was 75.72±11.08 mg/dl. The mean 2 hour. PG level was 124.71±10.75 mg/dl. 75.6% (155) of the pregnant women had normal vaginal delivery. 23.4% (48) of the study population had caesarean section.

Table 1: Demographic and clinical characteristics of study population.

Characteristics		N=205
Age in years (Mean±SD)		25.60±3.52
BMI (kg/m^2) (Mean±SD)		22.55±2.78
Parity n (%)	Primigravida	93 (45.4)
	Multigravida	112 (54.6)
Other risk factors n (%)	Absent	182 (88.8)
	Present	23 (11.2)
	Family history of DM	21 (10.2)
	Macrosomia/ Large for gestational age (LGA)	4 (2)
	Past history of GDM	2 (1)
Pregnancy complications n (%)	None	166 (80.9)
	Present	39 (19.1)
	GDM	16 (7.8)
	Pre-eclampsia	13 (6.3)
	Prematurity/preterm delivery	16 (7.8)
	IUGR	7 (3.4)
	Polyhydramnios	1 (0.5)
	Oligohydramnios	4 (2.0)
FPG (mg/dl) (Mean±SD)		75.72±11.08
2 hr. PG (mg/dl) (Mean±SD)		124.71±10.75
Mode of delivery n (%)	Normal delivery	155 (75.6)
	Forceps/vacuum	2 (1)
	LSCS	48 (23.4)

Table 2: Neonatal characteristics in the study population.

Characteristics	No. of neonates (n=205)	Percentage (%)
Birth weight (kg)		
<2.5	17	8.3
2.5-3.5	171	83.4
>3.5	17	8.3
Neonatal maturity		
Preterm	17	8.3
Term	188	91.7
Post term	-	-
Birth weight for gestational age of the neonates		
LGA	10	4.9
AGA	186	90.7
SGA	9	4.4
Neonatal complications		
Uncomplicated	178	86.8
Hypoglycemia	12	5.9
Respiratory distress	10	4.8
Neonatal hyperbilirubinemia	8	3.9
Birth asphyxia	7	3.4
TTN	5	2.4
MAS	2	0.9
Polycythemia	2	0.9

Table 3 shows the association of risk factors with prevalence of GDM. Maternal age ≥25 years is not statistically associated with prevalence of GDM in this study. BMI >25 kg/m^2, family history of diabetes, previous macrosomia/ LGA baby and past history of GDM have strongly significant association with the prevalence of GDM (p<0.001).

Table 3: Association of risk factors with prevalence of GDM.

Risk factors	No. of cases	No. of GDM cases	Percentage (%)	P value
Age ≥25 years	125	13	10.4	0.276
BMI >25 kg/m^2	28	16	57.1	<0.001
Family history of DM	21	10	47.6	<0.001
Previous macrosomia/ LGA baby	4	4	100	<0.001
Past GDM	2	2	100	<0.001

Maternal outcome in GDM cases was given in Table 4. Incidence of pre-eclampsia and polyhydramnios were significantly higher among GDM cases in this study. Prematurity or preterm labour was not significantly associated with GDM in this study (p = 0.466).

Table 4: Maternal outcome in GDM cases according to distribution of pregnancy complications in the study.

Pregnancy complications	No. of cases	In GDM cases	(%)	P value
Pre-eclampsia	13	4	30.8	0.0014
Prematurity	16	2	12.5	0.466
Polyhydramnios	1	1	100	<0.006
Oligohydramnios	4	0	-	-
IUGR	7	0	-	-

Table 5: Mode of delivery and birth weight of neonates in the study.

Mode of delivery	No. of cases	Birth weight (kg)		
		<2.5 kg	2.5-3.5 kg	>3.5 kg
Normal delivery	155	9 (5.8%)	139 (89.7%)	7 (4.5%)
Forceps/ Vacuum	2	0	1 (50.0%)	1 (50.0%)
LSCS	48	8 (16.7%)	31 (64.6%)	9 (18.8%)
Total	205	17 (8.3%)	171 (83.4%)	17 (8.3%)

5 (31.3%) of the 16 GDM women were managed with diet therapy alone. 11 (68.7%) of them required insulin for glycemic control along with diet therapy (Figure 1).

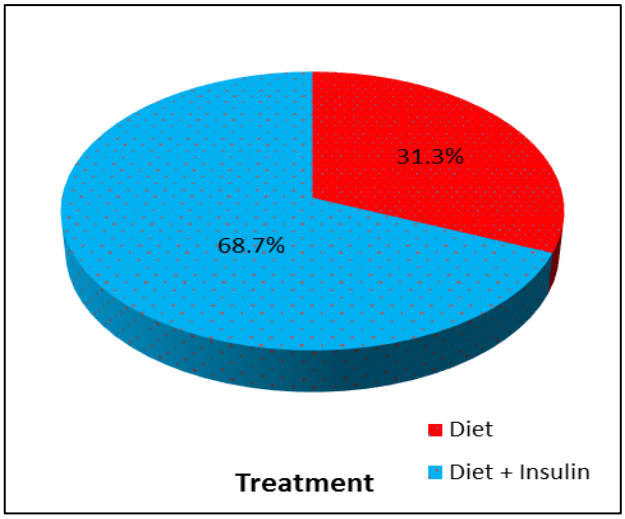

Figure 1: Treatment among GDM cases.

As shown in Table 5, operative delivery (cesarean section) and instrumental (forceps) assisted delivery had strongly significant association with GDM with p <0.001. GDM cases were significantly associated with higher birth weight (>3.5 kg) in the neonates with p<0.001. Large for gestational age (LGA) has strongly significant association with GDM in the study. 9 (90%) of the 10 LGA neonates were born to GDM women.

Table 6: Neonatal complications among GDM cases.

Neonatal outcome	No. of neonates (n=205)	In GDM cases (n=16)	Incidence (7.8%)	P value
Uncomplicated	178	7	3.9	0.0523
Hypoglycemia	12	7	58.3	<0.001
Respiratory distress	10	3	30.0	0.007
Neonatal hyper bilirubinemia	8	4	50.0	<0.001
Birth asphyxia	7	1	14.3	0.521
TTN	5	3	60.0	<0.001
MAS	2	0	0.0	-
Polycythemia	2	2	100.0	<0.001

Table 6 shows the distribution of neonatal complications among GDM cases. Hypoglycemia was the most common complication noted in neonates of GDM women in the study. 7 (43.6%) of the 16 neonates born to GDM women had hypoglycemia in the immediate postnatal period. Incidence of respiratory distress, transient tachypnea of the newborn (TTN), polycythemia and neonatal hyperbilirubinemia were also significantly more common among neonates born to GDM women (p <0.001).

DISCUSSION

There is an increase in the prevalence of GDM globally. Prevalence of GDM varies in direct proportion to the prevalence of type 2 DM in a given population or ethnic group.[1] Its prevalence ranged from 3.8 to 21% in different parts of India.[4] GDM has been found to be more prevalent in urban areas than in rural areas.[4] The GDM prevalence increased from 2% in 19825 to 7.62% in 1991.[11] The prevalence of GDM in this study population is 7.8%. The variation in prevalence of GDM in different studies is attributable to differences in geographical area, sample size, demographic characteristics of the study population and diagnostic method employed.

Incidence of GDM in a study population will depend on prevalence of various risk factors and degree of correlation of risk factors with GDM. In this study, maternal age ≥25 years were not statistically associated with prevalence of GDM in this study. On univariate analysis, we observed that BMI >25 kg/m^2, family history of diabetes, previous macrosomia/ LGA baby and past history of GDM have strongly significant association with the prevalence of GDM (p <0.01). On multiple logistic regression analysis, BMI >25 kg/m^2, previous LGA baby and past history of GDM have significant independent association with GDM. None of the pregnant women in this study had other risk factors like unexplained fetal or neonatal loss, previous still birth or past history of congenital anomalies in the off spring. Similar observations were also made by Seshiah et al.[12] He concluded that concluded that age ≥25 years, BMI ≥25 kg/m2 and family history of DM were not only significantly associated with the prevalence of GDM but were also found to have a significant independent association (p <0.001) with GDM. In another study by Jang et al found that the GDM women were older, had higher pre-pregnancy weight, higher BMI, higher parities and higher frequencies of known diabetes in the family. Of all the independent risk factors for GDM, BMI emerged as a modifiable risk factor.[13]

In the present study, 9 (56.3%) pregnant women with GDM did not have any other obstetric complications in the study. Pre-eclampsia was present in 4 (25%) of the GDM women. 1 GDM case had ployhyrdamnios. 2 (12.5%) women with GDM had preterm delivery. Similar observations were also made by Capula et al.[14] The difference in the incidence of pregnancy complications in various studies is mainly attributable to differences in the sample size, risk factors and whether treatment and non-treatment groups existed in the study design. Timely and proper treatment of GDM cases decreases the incidence of the complications.

There is increased rate of operative delivery in pregnancies complicated by GDM.[1,15] Cesarean delivery rate in the present study was 62.5% amongst the GDM patients. GDM cases were significantly associated with higher birth weight (>3.5 kg) in the neonates with p<0.001 and Mode of delivery is significantly associated with Birth weight (kg) with p <0.001. Recognition of GDM in early stages may lead to a lower threshold for surgical delivery that mitigates the potential benefits of treatment.

Perinatal complications seen commonly in these infants are macrosomia, birth injuries, shoulder dystocia, hyperbilirubinemia, hypoglycemia, respiratory distress syndrome, and childhood obesity.[1] These complications increase the risk of perinatal morbidity and mortality. Neonates born to GDM mothers are not at higher risk for congenital anomalies unless they have overt diabetes. The ADA has concluded that fasting hyperglycemia defined as >105 mg/dL may be associated with an increased risk of fetal death during the last 4 to 8 weeks of gestation.[16]

Hypoglycemia was the most common complication noted in neonates of GDM women in this study (43.6%). Incidence of respiratory distress, TTN of the newborn, polycythemia and neonatal hyperbilirubinemia were also significantly more common among neonates born to GDM women in the present study. Similar findings were also made by Capula et al.[14] On contrast to these findings, Kalra et al noticed neonatal hyperbilirubinemia was the common complication in their cases followed by hypoglycaemia.[17] No neonatal deaths were reported in the present study.

CONCLUSION

The prevalence of GDM in the study population was 7.8%. Hypoglycemia was the most common complication noted in neonates of GDM women in the study. The findings of the study conclude that BMI, parity, family history of diabetes, previous macrosomia/ LGA baby and past history of GDM had significant association with prevalence of GDM. The incidence of neonatal hypoglycemia in the study was 5.9%. Hence, early detection of GDM by identifying the risk factors and treatment at proper time will reduce both maternal and perinatal complications as well as the economic and social burden in untreated cases.

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