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Original Research Article

Risk factor for gestational diabetes mellitus and impact of gestational diabetes mellitus on maternal and fetal health during the antenatal period

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is defined as any degree of dysglycaemia that occurs for the first time or is first detected during pregnancy.

The adverse effects of GDM on pregnant women are pre-eclampsia, PIH, PPH, polyhydramnios, PROM, meanwhile, there would be an increase in dystocia, birth injury, and cesarean section

Methods: This retrospective study was conducted in a Gynecology clinic in District Shivpuri to find out the various risk factors for GDM and to evaluate the impact of GDM on maternal and fetal health during the antenatal period. 84 patients who were diagnosed with GDM were included in the study.

Results: Among risk factors; BMI >25 kg/m² before pregnancy was found in 15.47% of the case, family history of diabetes mellitus 8.33%, Previous history of macrosomia 17.85%, Poor reproductive history 17.85%, baby with congenital malformation 8.33%, H/o unexplained IUFD 11.90%. H/o polyhydramnios 15.47%. History of PCOS 13.09% and preeclampsia was found in 17.85% of cases. In antenatal complications; miscarriages was found in 15.47%. polyhydramnios in 17.85%. Oligohydramnios in 8.33%, preterm labor in 11.90%, PROM in 9.52%, pre-eclampsia in 17.85%, sudden IUFD in 8.33% and congenital malformation was found in 4.76% of cases. On USG; IUGR was found in 7.14% of cases. Large for date fetus in 16.66% of cases and the normal growth was found in 76.19% of cases.

Conclusions- In conclusion appropriate and timely diagnosis and treatment of GDM will result in decreased maternal and neonatal adverse outcomes comparable to general population rates, therefore, early diagnosis is important.

Keywords: GDM, Polyhydramnios, Macrosomia, Congenital malformation

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as any degree of dysglycemia that occurs for the first time or is first detected during pregnancy.¹ Diabetes mellitus complicates approximately 10% of all pregnancies. Gestational diabetes mellitus (GDM), or carbohydrate intolerance detected for the first time during gestation,

represents about 90% of all cases of diabetes in pregnancy.² The prevalence of GDM varies worldwide and among different racial and ethnic groups between a country. The prevalence of GDM in India varied from 3.8 to 14.3%.³ GDM occurs when the woman's beta cell function is not able to overcome the antagonism created by anti insulin hormones of pregnancy and the increased fuel consumption required to provide for the growing

fetometarnal unit.³ High risk factors for GDM are age >25, family history of diabetes in first degree relative, obesity (pre-pregnancy BMI >25), bad obstetric history: previous history of unexplained perinatal loss, intrauterine, fetal death, large for gestational age infants, (child with birth weight of >10), congenitally malformed infant, vpolyhydramnios and pregnancy induced hypertension, pregnant woman of member of ethnic group with high prevalence of GDM eg. Indian women.³ Low risk factors for GDM are age <25 years, weight normal before pregnancy (BMI <25), No known diabetes in first degree (mother, father, siblings) relatives, no history of abnormal glucose tolerance, no history of poor obstetric outcomes.³

A number of screening guidelines (ADA, WHO, CDA, NDDG and Australasian) are being followed in the same as well as in different countries. ADA recommendations in 2011 for diagnosis of GDM were developed by the American diabetes association (ADA) and the International association of diabetes and pregnancy Study groups (IADPSG). Women at an increased risk for type 2 diabetes should be screened for diabetes using standard diagnostic criteria at their first antenatal visit. Fasting glucose levels >126 mg/dl, or random glucose levels >200 mg/dl or glycosylated haemoglobin >6.5% are considered diagnostic overt (pregestational) diabetes and not gestational diabetes. In the Indian context, all women are best screened. At 24-28 weeks' gestation, all women not known to have diabetes (including women where the initial testing was normal) should undergo a 75 g oral glucose tolerance test (OGTT), with plasma glucose measurement at 1 and 2 hrs. The diagnosis of GDM is based on the finding of one abnormality (rather than the previously recommended two). The OGTT should be performed in the morning after an overnight fast of at least 8 hrs. The diagnosis of GDM is made when any of the following plasma glucose values are exceeded; fasting >92 mg/dl, 1 hr >180 mg/dl, and 2 hrs >153 mg/dl.⁴ The diabetes in pregnancy study-group India (DIPSI) has reported practice guidelines for diagnosis of GDM in the Indian environment which should be followed. This one step test is a modification of the 75 g OGTT and is recommended by federation of the obstetric and gynaecological societies of India (FOGSI) and DIPSI (diabetes in pregnancy study group in India), for ease of implementation in the Indian population. The main advantage is that she need not be fasting and hence it is more practical and economical. This test should be performed at the time of the first visit or at 14-16 weeks. Then if negative, it should be repeated at 24-28 week and at 32-34 weeks. The DIPSI criteria for diagnosis GDM (75-gram glucose powder dissolve in a glass of water. It is to be consumed within 5-10 minutes irrespective of the time of the last meal and she was asked not to eat and drink anything other than water for 2 hours). The venous plasma glucose cut-off value after 2 hours are shown.

The early screening before 24 weeks is recommended detect undiagnosed diabetes or GDM in early pregnancy

so that achievement of normoglycemia will decrease the adverse outcome. Gestational diabetes mellitus patients should be counselled about the associated risk like. Congenital anomalies, perinatal mortality, diabetic complications in pregnancy, obstetric complications and inheritance of diabetes in offspring. frequent antenatal visits and close supervision (team approach), strict blood glucose control, appropriate diet & lifestyle modification should be taken care of.⁵

The maternal complications associated with GDM are pre-eclampsia, polyhydramnios, preterm labor, premature rupture of membranes, in some cases prolonged labour, obstructed labour, cesarean section, uterine atony, postpartum hemorrhage and infection, meanwhile, there would be an increase in dystocia, birth injury, and cesarean section.⁶ The common medical complications associated with GDM are like hypoglycaemia, nephropathy, retinopathy, neuropathies are to be guarded against, hypoglycaemia has been reported in 6-41% of GDM pregnancies. Hypoglycaemia at night (Somogyi phenomenon) and hyperglycaemia at night (Down phenomenon) with fasting hypoglycaemia are also frequently encountered. Diabetic ketoacidosis tends to occur more frequently, and at lower blood glucose levels than in nonpregnant women. Proliferative retinopathy must be watched for. Proteinuria, and creating clearance may get altered during pregnancy.⁶

Evaluation of fetal well-being by serial ultrasound exam starting from the first trimester is recommended for all pregnant women with diabetes. An early pregnancy scan is performed at 7 to 8 week for accurate dating, so that iatrogenic prematurity can be avoided. A targeted scan (USG level II scan) at 18-20 weeks to rule out gross congenital abnormalities. Subsequently growth scans are carried out every 4 weeks for assessing fetal growth and liquor volume Doppler velocimetry is done if FGR is present. Biophysical profile/non-stress test would be done twice weekly especially in patients with FGR with abnormal umbilical artery Doppler, increased BP records of suboptimal control of diabetes or vasculopathy.⁵

Fetal and neonatal effects

Congenital malformations continue to affect 3-6% of all diabetic pregnancies, and account for 40% of all perinatal mortality.⁵ Most of these begin at the time of fetal organogenesis because of poor maternal glycaemic control during early pregnancy, early onset of vasculopathy, genetic susceptibility, ketoacidosis, hypoxia, exposure to teratogens, exposure to free radicals and lack of essential micronutrients during periods of critical fetal development. Fetal growth delay/IUGR babies show a significantly high incidence of fetal malformation. The incidence of intrauterine fetal deaths leading to unexplained stillbirth is higher in diabetic women, generally after 36 weeks, particularly so in women with poor glycemic control.^{5,6} Fetal macrosomia as the result of GDM is found in 30-40% patients³. These

babies are prone to suffer from effects of prolonged labours, birth injuries, shoulder dystocia, birth asphyxia, and meconium aspiration. Neonatal complications include higher risks of birth asphyxia, birth injuries, hyaline membrane disease causing respiratory distress syndrome, metabolic problems causing hypoglycemia, hypocalcaemia, neonatal infection, polycythaemia, and hyperbilirubinemia. Although, there has been a reduction in the incidence of fetal malformations, 2.5% of neonates manifest congenital defect which contribute to increased perinatal morbidity and perinatal mortality. The long-term effects include diabetes mellitus in later life, neurological deficits and childhood obesity.⁶

The most common congenital malformations in diabetic pregnancies are cardiovascular defects. The rate of cardiac malformation is fivefold higher in diabetes. Sacral agenesis/caudal regression is highly suggestive of diabetic fetopathy. It is a rare malformation but diagnosed up to 400 times more frequently in diabetic mothers and nearly pathognomic. There is a 10-fold increase in the incidence of CNS malformations in infants of diabetic mothers, including anencephaly, holoprosencephaly, open spina bifida, microcephaly, encephalocele, and meningomyelocele. GI system malformation and genitourinary system are more common anomalies in pregnancies complicated by diabetes.⁷ Medical management of GDM aims to optimize glycemic control to prevent or minimize the complications associated with the diseases, while avoiding ketosis and poor nutrition. The multidisciplinary approach (involving obstetricians, perinatologist, dietitians, diabetes educator, internist and endocrinologist) is essential to management. Diet, exercise, patients educations and if needed be medical therapies (insulin, oral anti-diabetic agents (OADs) should be utilized.⁵ Thus GDM is the most common complication of pregnancy, which affects both maternal and fetal health, even years after delivery. There is increased risk of maternal and prenatal complication. Early diagnosis and early treatment of maternal hyperglycemia has led to the reduction of the risks in mothers with GDM, in this way we can improve the prognosis and prevent maternal and fetal morbidity and mortality.

Aim

This retrospective study was done to find the various risk factors for GDM and to evaluate the impact of Gestational diabetes on maternal and fetal health during the antenatal period. Diagnosis of GDM primarily depends on the results of an oral glucose tolerance test (OGTT).

METHODS

It is a retrospective study between 1st January 2019 to 30 April 2021 conducted in a gynecology clinic in district Shivpuri. All patients attending the antenatal clinic for

routine check-up were given 75g glucose powder dissolve in a glass of water. It Is to be consumed within 5-10 minutes irrespective of the time of the last meal and she was asked not to eat and drink anything other than water for 2 hours the cut-off value was a venous plasma glucose cutoff of >140 mg/dl at (7.8mmol/l) at 2 hours. 84 patients who were diagnosed and GDM were included in the study.

Table 1: DIPSI criteria for screening cum diagnosis.³

2 hour plasma glucose (mg/dl)	In pregnancy	Outside pregnancy
≥ 200	Diabetes	Diabetes
140-199	GDM	IGT
120-139	GGI	-
<120	Normal	Normal

Table 2: Possible fetal risk in GDM patients.⁵

Pregnancy	Spontaneous abortion, congenital malformation, early IUGR.
2 nd Trimester	Macrosomia, CNS developmental delay
3 rd Trimester	Chronic hypoxemia, IUGR, stillbirth & IUD
During labor	Shoulder dystocia, birth injuries.
New born	Respiratory distress syndrome, hypoglycemia, hypocalcaemia, thrombocytopenia, polycythemia, hyperbilirubinemia, renal vein thrombosis, myocardial dysfunction
Child and adult	Birth injury, behaviour deficit, intellect deficit, intellect deficit, obesity, diabetes.

Data collected from the records of the patients include age, parity, BMI, residence and excess weight gain in pregnancy, Family history of diabetes mellitus, previous history of macrosomia, BOH, baby with congenital malformation, unexplained intrauterine fetal death unexplained polyhydramnios, GDM during previous pregnancy, polycystic ovary syndrome, preeclampsia, Hypothyroidism, and other relevant information . Growth and presence of any disparity and congenital malformation was observed by ultrasound. All the data were analyzed using IBM SPSS ver. 20 software. Cross tabulation and frequency distribution were used to prepare tables. Data are expressed as numbers, percentages, and mean.

RESULTS

In current study, 52% of patients were early GDM and diagnosed before 24 weeks of gestation and 48% of them were late GDM who were diagnosed after 24 weeks of gestation. Mean gestation age at first the visit was 14.4 weeks of gestation.

In current study, most 40.47% of the patient were in 26-30 years of age, the maximum number of patients were multiparous (63.09%), most (45.23%) of them were between 25-30 kg/m² of BMI most of the patients were from rural area (73.80).

In our study, maternal age >30 years was in 26.19% of patients. BMI >25 kg/m² before pregnancy was present in 15.47% of the case, excess weight gain in pregnancy in 17.85%. Family history of diabetes mellitus present in 8.33, previous history of macrosomia 17.85%, and Poor reproductive history 17.85%. Previous history of baby with congenital malformation 8.33%. Previous history of unexplained intrauterine fetal death 11.90%. Previous history of unexplained polyhydramnios 15.47%. Previous history of GDM during previous pregnancy 8.33, history of polycystic ovary syndrome 13.09%. Preeclampsia was found in 17.85% of cases and hypothyroidism was present in 5.95% of cases. In current study, miscarriage was found in 15.47% of cases. polyhydramnios was found in 17.85% of cases. Oligohydramnios was found in 8.33%, Preterm labour was 11.90%, PROM was found in 9.52% of cases. Recurrent moniliiasis was found in 13.09% of cases. Recurrent urinary tract infection was found in 21.42% of cases. Pre-eclampsia was found in 17.85% of cases. Diabetic ketoacidosis was found in 1.19% of cases. Sudden intrauterine fetal death was found in 8.33% of cases. Congenital malformation was found in 4.76% of cases. In current study, fetal growth retardation was found in 7.14% of cases. Large for date fetus was found in 16.66% of cases and the normal growth was found in 76.19% of cases.

Table 3: Demographic profile.

Parameters	N	%
Age (years)		
<20	0	0
21-25	29	34.52
26-30	34	40.47
31-35	15	17.85
>35	6	7.14
Total	84	100
Parity		
Primipara	31	37
Multiparous	53	63
Total	84	100
BMI (kg/m²)		
<20	1	1.19
20-25	31	36.90
26-30	38	45.23
>30	14	16.66
Total	84	100
Residence		
Urban	22	26.19
Rural	62	73.80
Total	84	100

Table 4: Clinical risk factors.

Clinical risk factor	N	%
Maternal age ≥ 30 years	22	26.19
BMI before pregnancy (>25 kg/m ²)	13	15.47
Excess weight gain in pregnancy	15	17.85
Family history of diabetes mellitus	7	8.33
Previous history of macrosomia	15	17.85
Poor reproductive history (>3 spontaneous abortions in the first or second trimester)	15	17.85
Previous history of baby with congenital malformation	7	8.33
Previous history of unexplained intrauterine fetal death	10	11.90
Previous history of unexplained polyhydramnios	13	15.47
Previous history of GDM during a previous pregnancy	7	8.33
History of polycystic ovary syndrome	11	13.09
Smoking during pregnancy	1	1.19
Preeclampsia	15	17.85
Hypothyroidism	5	5.95

Table 5: Maternal effect of GDM during the antenatal period.

Maternal	N	%
Miscarriage	13	15.47
Polyhydramnios	15	17.85
Oligohydramnios	7	8.33
Preterm labor	10	11.90
PROM (premature rupture of membrane)	8	9.52
Recurrent moniliiasis	11	13.09
Recurrent Urinary tract infections	18	21.42
Pre-eclampsia	15	17.85
Diabetic keto acidosis	1	1.19
Sudden intrauterine fetal death	7	8.33
Congenital malformation (patient-reported in last trimester)	4	4.76

Table 6: Effect on fetus (USG findings).

Fetal growth during pregnancy	N	%
Fetal growth retardation	6	7.14
Large for date fetus	14	16.6
Normal Growth	64	76.19

DISCUSSION

In our study, most 40.76% of the patient were in 26-30 years of age, the maximum number of patients were multiparous (63.09%), most (45.23%) of them were between 25-30 kg/m² of BMI most of the patients were from rural area (73.80%). Our study is comparable with the study of Anjana et al in which the majority of women

were between 26-30 of age, and the prevalence of GDM was double in multiparous patients. In one other study, maximum patients (56%) were found in the age group of 26-30 years. In the study form, Jammu also concludes that GDM is common in the older age group.⁸ In a study by Ameya et al, the maximum number of patients were in the age group of 26-30 years, 28% of patients were primigravida while 72% patients were multigravida.⁷ The study by Ameya et al also showed that higher parity would have a higher rate of GDM. One study shows that the prevalence of GDM was highest among Asian women with BMI>30kg/m² (13.78%), followed by BMI>25kg/m² (10.22%) and BMI>20kg/m² (6.09%).¹⁰ ADA recommended the lowest cutoff of ≥ 25 years to screen for GDM as early as possible.¹¹

According to previous studies, family history of diabetes (particularly in the first-degree relative) increase the risk for GDM.^{12,13} In current study among the risk factors; maternal age >30 years was in 26.19% of patients. BMI >25 kg/m² before pregnancy was present in 15.47% of the case, excess weight gain in pregnancy in 17.85% family history of diabetes mellitus 8.33, previous history of macrosomia 17.85%, and poor reproductive history 17.85%. Previous history of baby with congenital malformation 8.33%. Previous history of unexplained intrauterine fetal death 11.90%. previous history of unexplained polyhydramnios 15.47%. Previous history of GDM during previous pregnancy was present in 8.33%, history of polycystic ovary syndrome 13.09%. Preeclampsia was found in 17.85% of cases and hypothyroidism was present in 5.95% of cases.

Current study was in agreement with the study of Ameya et al in which risk factors were found in 90% of patients.⁹ In history anomalous baby was found in 4%, macrosomia was 18%, GDM in previous pregnancy was 6%, history of IUFD in 8%, history of previous abortion was in 10%. Pre-eclampsia (26%), hypothyroidism (6%), bad obstetric history in (18%), polyhydramnios (20%), other high-risk factors (previous LSCS, preterm labor, breech presentation, transverse lie, and placenta previa (20%) were found in GDM patients.⁸ Current study is not comparable with one another study in which maternal age 76.5%, family history of diabetes mellitus obesity was 44.4%, previous study of macrosomia was 3.6%, GDM during previous pregnancy was 3.1%, previous history of unexplained fetal death was 1.5%, hypertension was 1%, previous history of congenital malformation was 0.5%.¹⁴ Many studies have shown pre-pregnancy, obesity, and advanced age are closely related to GDM.^{15,16} In a trial conducted by Mashiah et al it was found that for every 3.5kg/m² increase in BMI in early pregnancy there is of GDM increase by 1.5 times.¹⁷ The study from Hong-kong, China also concluded that the risk of GDM significantly with the age of the pregnant woman. Retnakaran et al have shown that 38.1% of GDM have a family history of diabetes, which is a 2.9-fold increase in the risk of GDM compared with those without a family history of diabetes.¹⁸ In addition, the risk of GDM is

closely related to the postprandial hyperglycemia and high HbA1c of pregnant women.¹⁹

In the study conducted in the UK by Nanda et al positive family history was found in 23.9% of patients.²⁰ In current study, miscarriage was found in 15.47% of cases. Polyhydramnios was found in 17.85% of cases. Oligohydramnios was found in 8.33%, preterm labour was 11.90%, PROM was found in 9.52% of cases. Recurrent moniliasis was found in 13.09% of cases. Recurrent urinary tract infection was found in 21.42% of cases. Pre-eclampsia was found in 17.85% of cases. Diabetic ketoacidosis was found in 1.19% of cases. Sudden intrauterine fetal death was found in 8.33% of cases. Congenital malformation was found in 4.76% of cases. Current study was comparable with the study of Zhuang in which premature rupture of membrane (17.20%) and abnormal amniotic fluid was found in (13.49%) of cases which higher than our study.²¹ In one study in the case of oligohydramnios was 25%, polyhydramnios 18.75, PIH/preeclampsia/eclampsia 12.5, PROM 25%, polyhydramnios was found in 20% of our patients in this study.²² The study by Bhat et al cites a 14.7% incidence of polyhydramnios v/s 2.7% in controls.²³ Pre-eclampsia can complicate the course of pregnancy and hurts the fetomaternal outcome. In this study, 26% of GDM patients had associated preeclampsia. In the study by Saxena et al the incidence of pre-eclampsia was 40%.²⁴ According to Xiong et al mothers with GDM were at increased risk of presenting with pre-eclampsia.²⁵ It proves that there is an association between pre-eclampsia and GDM and early diagnosis and initiation of treatment should be done to improve the outcome. Jindal et al from Bhopal compared the pregnancy outcome in women with GDM and controls.²² They observed that whereas 32% in the GDM group showed excessive weight gain during pregnancy, the incidence was only 1.7% in controls. The incidence of PIH was 48% in the GDM group v/s 18.8% in controls, hydramnios was detected in 28% in the GDM group v/s 4.3% in controls; vulvovaginitis was reported in 4% in the FDM group v/s 1.3% in the control group. Lastly, a comparison of the fetal outcome revealed intrauterine fetal deaths in 12% of the GDM group v/s 1.7% in the control group fetal malpresentations were recorded in 16% of GDM group v/s 6% in control group, fetal macrosomia was present in 32% in the GDM group v/s 6.8% in the control group, and whereas 44.4% were delivered by cesarean section in the FDM group, the incidence of cesarean delivery in the control group was only 13.3% The above Indian study clearly brings out the enhanced obstetric risks in patient with gestational diabetes mellitus. In current study on ultrasound assessment fetal growth retardation was found in 7.14% of cases. Large for date fetus was found in 16.66% of cases and the normal growth was found in 76.19% of cases. The Indian consensus is that a newborn weighing >3.5 kg should be considered as macrosomia. In the study of Ameya et al 40% of babies were macrosomic at birth.⁹ In study of Buchanan et al the Incidence of low birth

weight was 28% in women in southern California and other high-risk ethnic groups.²⁶ In the study of Ahmad et al Lowerbirth weight of the fetus was in 17.9% of patients, macrosomia was in 16.6% and normal growth was in 65.5% of patients.²⁷

Limitations

The limitations of current study were; study cohort was small, pre-pregnancy weight told by the patients might not be accurate. Due to lack of admission facilities, we could not follow-up with patients during labor and in postnatal period.

CONCLUSION

In conclusion, the present study comprehensively analyzed the risk factors of gestational diabetes, In the study, the impact of age and BMI on GDM was reported, and the effects of the family history of diabetes, history of GDM during a previous pregnancy, previous history of macrosomia, poor reproductive history, previous history of baby with congenital malformation and PCOS were also reported. Untreated GDM has been reported to be associated with significant maternal and neonatal morbidity. Appropriate and timely treatment will result in decreased maternal and neonatal adverse outcomes comparable to general population rates therefore, early diagnosis is important. Early intervention and treatment will result in good perinatal outcomes and decrease maternal and fetal complications such as congenital anomaly, unexplained fetal death, preterm delivery, hydramnios, macrosomia, and maternal metabolic complications. The patients of diabetes need antepartum fetal surveillance testing and they may require delivery before their estimated date of delivery (EDD). Timely screening of GDM results in early diagnosis and treatment in this we can improve the prognosis and prevent maternal and fetal morbidity and mortality. Women with GDM should have preconception counselling if contemplating a further pregnancy to minimize the risk of future pregnancy complication.

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