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ASSOCIATION OF MATERNAL LIPID PROFILE IN GESTATIONAL DIABETES MELLITUS AND MACROSOMIA

Obstetrics & Gynaecology

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ABSTRACT

Background: This study was aimed to determine the association of maternal lipid profile in gestational diabetes mellitus (GDM) and macrosomia. **Methods:** A cross- sectional study was conducted in the department of Obstetrics and Gynaecology at Ballari Medical College and Research Centre (BMCRC). The study was conducted for 6 months duration from 1st August 2023 to 31 st January 2024. All the patients were subjected to check fasting serum TG, FBS, PPBS. Descriptive statistics like mean, standard deviation and inferential statistics like Chi-square test were used for comparing study variables between large for gestational age (LGA) and non LGA group. T-test was used to compare the mean values of age, pre-pregnancy BMI, pregnancy weight gain, OGTT, FBS, PPBS, fasting serum TG between LGA and non LGA groups. **Results:** The observed mean TG values in LGA and non LGA groups in our study were 225±25.0 and 160±14.0 mg/dL respectively. The serum TG values in the LGA group mothers were significantly higher when compared to the non LGA group. The mean weight gain in pregnancy were 14.8±1.9 and 10.1±1.5 in LGA and non LGA groups. The mean BMI comparison among LGA and non LGA groups were 26.8±1.9 and 23.2±1.8 respectively. **Conclusion:** Our study clearly pointed out that maternal fasting serum TG was elevated in LGA babies. Hence, measuring serum TG is useful in GDM. In addition to maternal hypertriglyceridemia, pre-pregnancy BMI, excessive weight gain in pregnancy were significantly associated with foetal macrosomia in GDM mothers.

KEYWORDS

Maternal Lipid Profile, Gestational Diabetes Mellitus, Macrosomia

INTRODUCTION

Gestational Diabetes Mellitus (GDM) is the most prevalent metabolic disorder during pregnancy affecting up to 25% of pregnancies [1]. Women with GDM have a higher risk of pre-eclampsia, macrosomia, pre-term birth, caesarean delivery, and still-birth [2, 3]. Infants of women with GDM have higher rates of neonatal hypoglycaemia and admission to neonatal intensive care units [4]. Further, women who develop GDM have approximately 10 times higher risk of T2DM later in life, and up to half will develop T2DM within 10 years after delivery [5,6]. Infants of mothers with GDM also have a higher risk of glucose intolerance, obesity, and diabetes during childhood and as adults.

The best screening program to detect GDM remains controversial [7]. Currently, the American Diabetes Association recommends pregnant women to undertake GDM screening with the Oral Glucose Tolerance Test (OGTT) at 24 to 28 weeks of gestation [8]. However, universal screening for GDM using this strategy can pose challenges in rural or low-resource setting, where fasting or prolonged testing (as is required for the OGTT) is not practical. Further, screening at 24 to 28 weeks gestation may be too late to prevent some of the complications associated with GDM. Earlier screening for GDM could allow for more targeted testing and earlier intervention for at-risk groups, which in turn could mitigate adverse pregnancy outcomes.

Although the cause of GDM is not fully understood, maternal obesity, increasing maternal age, and women from certain ethnic groups have been identified as high risk [9]. Increasingly, attention has been given to the associations between impaired glucose metabolism, abnormal circulating lipid levels, and consequent worsening of glucose intolerance [10]. The exact relationship between maternal plasma lipid metabolism and maternal glucose remains unclear. Recent studies have highlighted that GDM induces a state of dyslipidaemia consistent with insulin resistance [11,12].

This study was aimed to determine the association of maternal lipid profile in gestational diabetes mellitus and macrosomia.

METHODOLOGY

This prospective cross- sectional study was conducted in Department of OBG, Ballari Medical College and Research Centre between 1 st August 2023 to 31 st January 2024. The Institutional Board of Ethics committee has approved the study and signed informed consents were obtained from participants.

All GDM women admitted under Department of OBG, BMCRC, after application of inclusion and exclusion criteria were taken up for the study.

Oral glucose tolerance test and blood sugar (Fasting and post-prandial) were done. All the patients were subjected to check fasting serum TG by collecting venous blood from antecubital vein under strict aseptic precautions after 12 hours of fasting. Serum TG was estimated using Randox reagent Imola autoanalyzer, manufactured in 2007, United Kingdom. Data has been checked for consistency and completeness was analysed by using SPSS version 21.0 IBM. Descriptive statistics like mean, standard deviation, percentages and frequencies were used. Inferential statistics like chi-square test was used for comparing age, parity, pre- pregnancy BMI, pregnancy weight gain, FBS, PPBS, mode of delivery, glycaemic control between LGA and Non LGA groups. T test was used to compare mean values of age, pre-pregnancy BMI, pregnancy weight gain, OGTT, FBS, PPBS, fasting serum TG between LGA and non LGA groups. A P value of <0.05 was considered as statistically significant.

Inclusion Criteria

Women with GDM admitted in the Department of Obstetrics and Gynaecology, BMCRC .

Exclusion Criteria

- Patients with other systemic diseases like overt DM, thyroid disorder or any chronic illness.
- After taking an informed written consent and fulfilling the inclusion criteria, patients were enrolled for the study.

Sample Size Estimation

Sample size was estimated by using the Prevalence of Gestational Diabetes Mellitus from the study of Bharathi DS et al [18].

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

Here

$Z_{1-\alpha/2}$ = Is standard normal variate (at 5% type 1 error ($P<0.05$) it is 1.96 and at 1% type 1 error ($P<0.01$) it is 2.58). As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula.

p = Expected proportion in population based on previous studies or pilot studies.

d = Absolute error or precision – Has to be decided by researcher.

P = 20% or 0.02
q = 95.67 or 0.9567
d = 10% or 0.10

Using the above values at 95% Confidence level, a sample size of 30 subjects has been included in the study.

RESULTS

Figure 1 represents the distribution of patients based on fasting serum triglyceride (TG) levels according to adult treatment panel III guidelines on National Cholesterol Education Program among the 30 patients. A total of 14 patients (47.8%) had normal fasting serum TG levels (<135 mg/dL). Borderline level (155-199 mg/dL) was observed in 8 patients (25.3%). High fasting serum TG levels (200 mg/dL and above) were noted in 8 patients (26.9%). This distribution highlights that nearly half of the patients had normal TG levels, while the remaining were fairly evenly split between borderline and high TG levels.

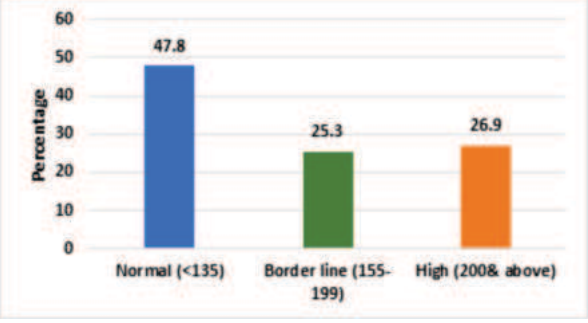

Figure 1: Distribution Of Patients Based On Fasting Serum TG Level, (n=30)

Table 1: Background Characteristics Of Patients (n=30)

Patient Characteristics	Mean ± SD
Age in completed (Years)	28.5 ± 4.2
Pre-pregnancy BMI (Kg/m²)	23.8 ± 3.1
Weight gain in pregnancy (kg)	10.5 ± 3.0
Screening OGTT value (mg/dL)	150.0 ± 6.5
Fasting blood sugar (mg/dL)	94.5 ± 7.3
Postprandial blood sugar (mg/dL)	125.2 ± 18.4
Fasting serum triglyceride (mg/dL)	179.4 ± 44.7
Birth weight (kg)	3.350 ± 0.60

Table 1 shows the background characteristics of 30 patients. The mean age of the patients was 28.5 years (±4.2). The average pre-pregnancy BMI was 23.8 kg/m² (±3.1), and the mean weight gain during pregnancy was 10.5 kg (±3.0). The screening OGTT value averaged 150.0 mg/dL (±6.5), with a mean fasting blood sugar level of 94.5 mg/dL (±7.3) and postprandial blood sugar level of 125.2 mg/dL (±18.4). The fasting serum triglyceride level was 179.4 mg/dL (±44.7), and the mean birth weight of the newborns was 3.350 kg (±0.60).

Table 2: Predictors Of Foetal Macrosomia In GDM Mothers (n=30)

Predictive Variables	Non LGA (Mean ± SD)	LGA (Mean ± SD)	Mean Difference	95% CI	P value
Age (Years)	29.1 ± 3.5	30.2 ± 4.2	-1.10	-0.8, 3.2	0.210
Pre-pregnancy BMI	23.2 ± 1.8	26.8 ± 1.9	-3.60	(-4.4, -2.8)	0.000
Pregnancy weight gain	10.1 ± 1.5	14.8 ± 1.9	-4.70	(-5.3, -4.1)	0.000
OGTT	151.5 ± 5.0	150.5 ± 7.8	1.00	-2.0, 4.0	0.750
FBS	95.0 ± 6.5	96.5 ± 8.5	-1.50	-5.0, 2.0	0.320
PPBS	127.0 ± 16.8	130.5 ± 20.5	-3.50	-13.0, 6.0	0.280

Table 2 presents the predictors of foetal macrosomia in GDM mothers among 30 patients. The mean age for the non-LGA group was 29.1 years (±3.5), while for the LGA group, it was 30.2 years (±4.2) with a mean difference of 1.10 years, which was not statistically significant (p=0.210). The pre-pregnancy BMI was significantly higher in the LGA group (26.8 ± 1.9) compared to the non-LGA group (23.2 ± 1.8), with a mean difference of -3.60 (95% CI: -4.4, -2.8) and a p-value of 0.000. Pregnancy weight gain was also significantly higher in the LGA group (14.8 ± 1.9 kg) compared to the non-LGA group (10.1 ± 1.5 kg), with a mean difference of -4.70 (95% CI: -5.3, -4.1) and a p-value of 0.000. There were no significant differences between the groups for OGTT, fasting blood sugar, and postprandial blood sugar levels.

Table 3: Fasting Serum TG Comparison (n=30)

Predictive Variables	Non LGA (Mean ± SD)	LGA (Mean ± SD)	Mean Difference	95% CI	P value
Fasting serum triglyceride	160.0 ± 14.0	255.0 ± 25.0	-95.0	(-105.0, -85.0)	0.000

Table 3 compares the fasting serum triglyceride levels between Non-LGA and LGA groups among 30 patients. The non-LGA group had a mean fasting serum triglyceride level of 160.0 mg/dL (±14.0), whereas the LGA group had a significantly higher mean level of 255.0 mg/dL (±25.0). The mean difference was -95.0 (95% CI: -105.0, -85.0), and this difference was statistically significant with a p-value of 0.000.

Table 4: Pre-pregnancy BMI Comparison (n=30)

Mode of delivery	Non LGA, n (%)	LGA, n (%)	P value
Caesarean section	6 (46.15)	7 (53.8)	0.000
Vaginal delivery	15 (87.5)	2 (12.5)	

Table 4 examines the pre-pregnancy BMI categories among 30 patients. In the Normal BMI category, 18 patients (94.7%) were in the non-LGA group, and only 1 patient (5.3%) was in the LGA group. Conversely, in the overweight and obese category, 3 patients (33.3%) were in the non-LGA group, while 8 patients (66.7%) were in the LGA group. This difference was statistically significant with a p-value of 0.000.

Table 5: Comparison Based On Mode Of Delivery (n=30)

Mode of delivery	Non LGA, n (%)	LGA, n (%)	P value
Caesarean section	6 (46.15)	7 (53.8)	0.000
Vaginal delivery	15 (87.5)	2 (12.5)	

Table 5 shows the comparison of mode of delivery in non LGA and LGA groups. Vaginal delivery was observed to be very less in LGA group (12.5%). Caesarean section rate was high in LGA group (53.8%). The comparison results based on mode of delivery was statistically significant.

Table 6: Comparison Based On Glycaemic Control (n=30)

Glycaemic control	Non LGA, n (%)	LGA, n (%)	P value
Controlled	17 (85)	3 (15)	0.000
Uncontrolled	4 (40)	6 (60)	

Table 6 shows the comparison between LGA and non LGA groups based on their glycaemic control. 15% study population delivered LGA babies in spite of well controlled sugars and 60% of LGA babies have uncontrolled sugars in mothers. Despite uncontrolled glycaemic status, 40% of population delivered non LGA babies. Comparison results based on glycaemic control was statistically significant.

DISCUSSION

The incidence of LGA newborns in healthy pregnancies is typically less than 10%. In GDM, macrosomia occurs in 15–45% of cases. A considerable fraction of pregnancies involving diabetes are still complicated by macrosomia. Strict glycaemic control can occasionally fail to prevent macrosomia, indicating abnormalities in

protein and lipid metabolism in addition to glucose metabolism. Diabetic mothers who have poor glycaemic control during pregnancy are more likely to give birth to babies with macrosomia than mothers who have good glycaemic control. Predicting foetal macrosomia in GDM is crucial for figuring out the obstetrical prognosis.

The results of this study showed that high blood sugar levels prior to pregnancy, excessive weight gain in pregnancy, and hypertriglyceridemia are all independent and substantial risk factors for term delivery of macrosomia in GDM mothers. In our study, a positive correlation has been observed between maternal fasting serum TG level and newborn birthweight in GDM mothers.

In our study, the mean age of the patients was 28.5 years (±4.2). The average pre-pregnancy BMI was 23.8 kg/m² (±3.1), and the mean weight gain during pregnancy was 10.5 kg (±3.0). The screening OGTT value averaged 150.0 mg/dL (±6.5), with a mean fasting blood sugar level of 94.5 mg/dL (±7.3) and postprandial blood sugar level of 125.2 mg/dL (±18.4). The fasting serum triglyceride level was 179.4 mg/dL (±44.7), and the mean birth weight of the newborns was 3.350 kg (±0.60) which is similar to the study done by Mossayebi et al [13] (197.5±51) and Wang et al [14] (173±59).

The mean age for the non-LGA group was 29.1 years (±3.5), while for the LGA group it was 30.2 years (±4.2), with a mean difference of 1.10 years, which was not statistically significant (p=0.210). The pre-pregnancy BMI was significantly higher in the LGA group (26.8 ± 1.9) compared to the non-LGA group (23.2 ± 1.8), with a mean difference of -3.60 (95% CI: -4.4, -2.8) and a p-value of 0.000. Pregnancy weight gain was also significantly higher in the LGA group (14.8 ± 1.9 kg) compared to the non-LGA group (10.1 ± 1.5 kg), with a mean difference of -4.70 (95% CI: -5.3, -4.1) and a p-value of 0.000. There is significant difference in glycaemic control 60% in LGA and 40% in non LGA groups.

The incidence of foetal macrosomia was also higher among GDM mothers with hypertriglyceridemia. Son et al observed 283.42 and 203.71 mg/dL in LGA and non LGA groups respectively [15]. In the study conducted by Gutaj et al, the values in LGA and non LGA groups were 231.16 and 205.48 respectively [16]. There was a significant rise in maternal fasting serum TG level in LGA group than the non LGA group and it was proved to be the most independent risk factor for macrosomia in GDM mothers.

According to literature, it is known that maternal obesity is a major risk factor for macrosomia, especially in GDM mothers. Our study results also confirm this finding. The mean BMI observed in our study was 24.22±2.714 corresponds with the 23.2±4.1 and 22.6±2.3 observed by Son et al and Mossayebi et al respectively [13,15]. Cruz et al reported that overweight and obesity in early pregnancy was associated with foetal macrosomia [17].

CONCLUSION

A common morbidity that can cause problems for the mother and the foetus is foetal macrosomia. One known cause of macrosomia is GDM. Therefore, maintaining glucose levels close to normal is the primary goal of preventative interventions. Some patients give birth to macrosomic infants even with appropriate glycaemic control. This implied that in addition to anomalies in glucose metabolism, macrosomia is also linked to abnormalities in protein and lipid metabolism.

These findings back up the assessment of lipid profile during pregnancy, which may be helpful in determining the type of metabolic aberration present in GDM, measuring it, and forecasting the outcome for the foetus. This method shows good correlation with a secondary study of the adverse pregnancy outcome (HAPO) and hyperglycaemia data, which indicates that maternal obesity and elevated glucose levels have a separate impact on excessive fetal growth. Given the aforementioned research, it is crucial to assess the lipid profile during pregnancy, paying special attention to TG levels, in addition to measuring hyperglycaemia. It is also important to encourage women to reduce their weight thereby adjusting to normal BMI before becoming pregnant, because having a subclinical metabolic disorder before becoming pregnant can cause GDM to develop during pregnancy and have negative effects.

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