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Association Of Mid-Trimester Ultrasound Fetal Liver Length And Gestational Diabetes Mellitus

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Abstract

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Introduction

Gestational diabetes mellitus (GDM) is a global public health problem, and has operationally been defined as any degree of glucose intolerance with onset or first recognition during pregnancy[1,2].In India alone, GDM complicates nearly 4 million pregnancies annually, the prevalence of GDM is 17.8% in urban, 13.8% in semi-urban, and 9.9% in rural areas, representing large subset of population at high risk for adverse perinatal morbidity and mortality if left inappropriately managed[3]. Untreated GDM results in adverse maternal and fetal outcomes such as increased risk of preterm delivery, preeclampsia, macrosomia or large for gestational age (a known risk factor for birth injury), operative delivery, stillbirth, respiratory distress syndrome, and neonatal hypoglycemia. The oral glucose tolerance test (OGTT) is considered to be the gold standard for diagnosis of GDM and is superior to fasting plasma glucose (FPG) and the glycosylated hemoglobin (HbA1c) level. The Diabetes in Pregnancy Study Group of India (DIPSI) guidelines is followed in India which is universal single step procedure, both screening as well as diagnostic[4]. Fetal growth is evaluated during USG throughout gestation by measuring various fetal body dimensions. Some of these fetal body dimensions, such as fetal liver length (FLL), could be considered as ultrasound parameters of glycemic control. Increased glucose transfer from the diabetic mother to the fetus and placenta results in fetal hyperglycemia and hyperinsulinemia, promoting growth of insulin-dependent tissues and organs, such as the liver[5]. Another screening method that can be performed during routine ultrasound assessment of pregnancy may be of value. The aim of this study is to know association of GDM with Fetal liver length which if found positive can serve as non-invasive indicator of maternal glycemic control and also be helpful in picking missed cases of GDM. And to find an appropriate cut-off value of fetal liver length for prediction of Gestational Diabetes Mellitus.

Methodology

A cross sectional study was conducted from June 2019 to May 2020 on Pregnant women attending ANC clinic at Department of Obstetrics and Gynecology, SMS Jaipur. Ninety singleton pregnant women of gestational age 23-26 weeks at high risk for GDM with confirmed gestational age, first trimester 2hr blood sugar <126mg/dl (as per DIPSI criteria) and pregnant women with one or more high risk factors Multiparity, BMI >30kg/m2, Previous delivery of macrosomic child (>4kg), Polycystic ovarian syndrome, Family history of diabetes were recruited in our study.

Known case of Diabetes Mellitus, Hypertension, Pre-eclampsia, IUGR, Fetal anomalies, ABO Incompatibility were excluded from study. After written informed consent, a complete obstetrical examination done along with DIPSI test and FLL

measurements were performed during routine ultrasound scan between 23-26 weeks. Pregnant women were subjected to DIPSI testing in which 75gm anhydrous glucose was given orally after dissolving in approximately 300ml water, whether the pregnant women came in fasting or non-fasting state, irrespective of the last meal. The threshold blood sugar level of ≥140mg/dl was taken as cut off for diagnosis of GDM. Classified as GDM and non-GDM on basis of DIPSI criteria. Both the groups were advised ultrasound for fetal liver length (FLL). A sagittal or coronal section of fetal abdomen was used to measure fetal liver length, the tip of the right lobe of the liver was identified and the liver length was measured from the dome of the right hemi diaphragm to the tip of the right lobe. All the data were recorded in a pre-structured proforma. Statistical analysis was done from the data. Correlations between the mid-trimester FLL and DIPSI were made. Chi-square test and Fisher Exact test used for categorical variables. Sensitivity, Specificity, PPV, NPV was calculated using standard formulae. ROC curve analysis was made to find out appropriate cut-off value of fetal liver length for prediction of GDM. P value <0.05 was taken as significant.

Result

90 women of gestational age 23-26 weeks were included in our study among which 24 were diagnosed with GDM on the basis of DIPSI and 66 were non-GDM.

As observed from table 1, the mean BMI was significantly higher in the GDM group 29.64 (±1.93) Kg/m2 as compared to the non-GDM group 26.92 (±2.46) Kg/m2 (p ≤0.001), with the median BMI being highest in the GDM group. 54.2% of the participants in the GDM group had BMI 30.0-34.9Kg/m2. For every 1 unit increase in BMI (Kg/m2), the DIPSI (mg/dL) increases by 5.49 units.

From table 2, 41.7% of the participants in the GDM group had history of macrosomia in previous pregnancy as compared to only 4.5% in non-GDM group and this was statistically significant (p <0.001).

Table 3, 29.2% of the participants in the GDM group had PCOS whereas in non-GDM group only 7.6% participants had PCOS. Statistically significant association was seen between GDM and PCOS in our study (p =0.013).

table 4, In our study 58.3% of the participants in the GDM group had family history of Diabetes whereas in non-GDM group only 10.6% of participants had family history of diabetes and this difference was statistically significant (p<0.001).

table 5, In our study, the mean Fetal Liver Length (mm) in the GDM group and non-GDM group was 37.75 (±1.28) and 29.09 (±2.81) respectively. The median Fetal Liver Length (mm) in the GDM group and non-GDM group was 37.8 and 29.3 respectively. There was a significant difference between the 2 groups in terms of Fetal Liver Length (mm) (p <0.001), with the median Fetal Liver Length being highest in the GDM group. For every 1 unit increase in DIPSI (mg/dL), the Fetal Liver Length (mm) increases by 0.13 units. Majority (95.8%) of the participants in the GDM group had Fetal Liver Length >35mm whereas in non-GDM group only 4.5% of the participants had Fetal Liver Length >35mm, which was statistically highly significant (p value <0.001).

From table 6, We observed that at a cutoff of Fetal Liver Length (mm) ≥36, it predicts GDM with a sensitivity of 96%, specificity of 97%, Positive Predictive Value of 92.0%, Negative Predictive Value of 98.5%, Diagnostic Accuracy of 96.7%, Positive Likelihood Ratio of 31.63 and Negative Likelihood Ratio of 0.04.

"Table No.1: Association between GDM and BMI"

BMI (Kg/m2)	GDM		Wilcoxon-Mann-Whitney U Test	
	Present	Absent	W	p value
Mean (SD)	29.64 (1.93)	26.92 (2.46)	1289.500	<0.001

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BMI (Kg/m2)	GDM		Wilcoxon-Mann-Whitney U Test	
	Present	Absent	W	p value
Median (IQR)	30.2 (28.02-31.13)	26.15 (25-28.78)		
Range	26.3 - 32.6	23.3 - 32.2		

"Table No. 2: Association Between GDM and Previous Baby >4Kg"

Previous Baby >4Kg	GDM			Fisher's Exact Test	
	Present	Absent	Total	χ2	P Value
Present	10 (41.7%)	3 (4.5%)	13 (14.4%)	19.625	<0.001
Absent	14 (58.3%)	63 (95.5%)	77 (85.6%)		
Total	24 (100.0%)	66 (100.0%)	90 (100.0%)		

"Table No.3: Association Between GDM and PCOS"

PCOS	GDM			Fisher's Exact Test	
	Present	Absent	Total	χ2	P Value
Present	7 (29.2%)	5 (7.6%)	12 (13.3%)	7.100	0.013
Absent	17 (70.8%)	61 (92.4%)	78 (86.7%)		
Total	24 (100.0%)	66 (100.0%)	90 (100.0%)		

"Table No.4: Association Between GDM and F/H Diabetes"

F/H Diabetes	GDM			Chi-Squared Test	
	Present	Absent	Total	χ2	P Value
Present	14 (58.3%)	7 (10.6%)	21 (23.3%)	22.411	<0.001
Absent	10 (41.7%)	59 (89.4%)	69 (76.7%)		
Total	24 (100.0%)	66 (100.0%)	90 (100.0%)		

"Table No.5: Association Between GDM and Fetal Liver Length"

Fetal Liver Length (mm)	GDM		Wilcoxon-Mann-Whitney U Test	
	Present	Absent	W	p value
Mean (SD)	37.75 (1.28)	29.09 (2.81)	1565.500	<0.001
Median (IQR)	37.8 (37.15-38.7)	29.3 (27.1-30)		
Range	34 - 40	24 - 38		

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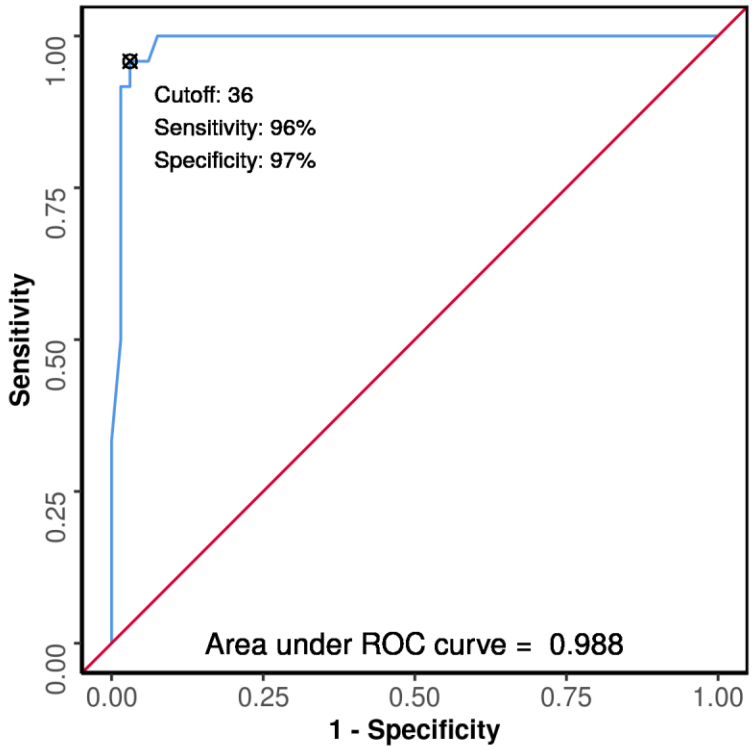
Table No.6

Variable	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
Fetal Liver Length (mm) (Cutoff: 36 by ROC)	95.8% (79-100)	97.0% (89-100)	92.0% (74-99)	98.5% (92-100)	96.7% (91-99)
Fetal Liver Length	95.8% (79-100)	95.5% (87-99)	88.5% (70-98)	98.4% (92-100)	95.6% (89-99)

ROC Curve Analysis Showing Diagnostic Performance of Fetal Liver Length (mm) in Predicting GDM vs non-GDM (n = 90)



Discussion

Diabetes is the most common metabolic disorder that is encountered during pregnancy, with gestational diabetes being the commonest form (up to 90% of cases). GDM entails an increased risk for both the mother and the fetus including major congenital malformations, increased incidence of obstetric complication, increased incidence perinatal morbidity. The prevalence of GDM in our study was 26.7%. In another study by M Perovic et al [6] the prevalence of GDM was relatively high in high-risk group (25.7%).

In our study we observed that the mean BMI in the GDM group and NONGDM group was 29.64 and 26.92Kg/m2 respectively. Majority of women in GDM group had BMI >30Kg/m2 and in non-GDM group, majority had BMI <25Kg/m2. There was a moderate positive correlation between BMI (Kg/m2) and DIPSI (mg/dL), and this correlation was statistically significant (p <0.001). For every 1 unit increase in BMI (Kg/m2), the DIPSI (mg/dL) increases by 5.49 units. In a study by Sudipta Pramanick et al [7] the difference of BMI (26.5 vs 22.5) in GDM and control group were statistically significant.

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In our study, 41.7% of the participants in the GDM group had Previous Baby >4Kg. Our findings were in accordance with study by Shridevi A. S et al [8] which showed that 34.78% of women with GDM had a previous macrosomic babies (Body wt. >4000 gm).

In our study, 29.2% of the participants in the GDM group had PCOS whereas in non-GDM group only 7.6% participants had PCOS. Statistically significant association was seen between GDM and PCOS (p value =0.013). In a study by Sanna Mustaniemi et al [9]

In our study, 58.3% of the participants in the GDM group had family history of Diabetes whereas in non-GDM group 10.6% of participants had family history of diabetes. Waleed M. Fathy et al [10], in his study reported a positive family history of diabetes in 45% of the women with GDM compared with 5.2% in the control group.

The present study has demonstrated that there is a highly significant correlation between FLL and GDM. The mean Fetal Liver Length (mm) in the GDM group and non-GDM group was 37.75 (±1.28) and 29.09 (±2.81) respectively. Our study demonstrated that fetal liver measurements during the mid-trimester ultrasound examination can be used to predict GDM in a high-risk population. There was a strong positive correlation between Fetal Liver Length (mm) and DIPSI (mg/dL), and this correlation was statistically significant (p <0.001). For every 1 unit increase in DIPSI (mg/dL), the Fetal Liver Length (mm) increases by 0.13 units. The area under the ROC curve (AUROC) for Fetal Liver Length (mm) predicting GDM vs non-GDM was 0.988 (95% CI: 0.97 - 1), thus demonstrating excellent diagnostic performance.

In a study Gharib WF et al [11], where the ROC curve analysis for the relation between FLL measured at 28 weeks of gestation and the incidence of diabetes during pregnancy concluded that, the chosen cut-off value for fetal liver length at 28 weeks, which represented the best compromise between sensitivity and specificity, was 53.8mm with sensitivity of 100% and specificity of 92% in prediction of diabetes with pregnancy. (AUC = 97%), with significant p value =0.001. Elwahab et al [12] assessed the relation between mid-trimester ultrasound FLL at 20 - 24 weeks with a 75gm OGT in 150 singleton pregnant women with a high risk for GDM at 24 - 28 weeks gestation. The mean FLL in GDM was significantly greater than in normal pregnant women (36.55 vs. 33.93mm) respectively.

In a study by Perovic et al [6] of 331 women with singleton pregnancy and at high risk for gestational diabetes. In their study, a positive correlation was found between FLL measurements at the 23-week ultrasound and 100gm OGTT measured at 24 weeks‟ gestation. The cut-off value of 39mm was established, with a sensitivity and specificity of 71.76% and 97.56% respectively, and positive and negative predictive values of 91.0% and 90.9%, respectively.

Conclusion

The finding of our study suggest that mid-trimester fetal liver length appears to be longer in GDM than in normal pregnancies. Fetal liver length can be performed during routine ultrasound at 23-26 weeks of pregnancy in women at high risk for GDM. At cutoff value of ≥36mm, it can serve as non-invasive indicator of maternal glycemic control and also be helpful in picking missed cases of GDM. However further well-designed studies are needed to corroborate current findings.

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