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Correlation of Ultra Sonographic Screening of Umbilical Cord Parameters &Adverse Birth Outcome in Gestational Diabetes Mellitus.

[1]Dr. M. Muhil,[2] Dr. Umapathy Sembian, [3]D.Priyanka, [4]Dr. Guru.T.Arun,
[1]Associate Professor of Physiology,[2] Associate Professor of Anatomy, [3] CRRI MBBS student, [4]Associate Professor of Radiology,
Trichy SRM Medical College Hospital and Research center Irunglur, Trichy 621105.
**Corresponding author: Dr. M. Muhil*

Abstract: *Gestational diabetes Mellitus is defined as impaired carbohydrate tolerance first recognized during pregnancy, which has adverse maternal and fetal outcome. It may result in Macrosomia or IUGR both of which have a low APGAR score. This study aims to predict these fatal complications in antenatal period by ultra-sonogram screening in the second trimester of pregnancy by checking for Umbilical cord thickness and umbilical cross sectional area which are routinely not measured but are known to be good predictors of birth weight and APGAR score. The study was carried out among the patients attending regular antenatal check up in the department of Obstetrics and Gynecology in Trichy SRM, and screened for GDM at 20- 24 weeks (n=100). The study participants and controls were subjected to Ultra sonogram at 20-24 weeks and Umbilical cord Thickness and cross sectional area were measured which had a significant correlation with Birthweight and APGAR score (p<0.005).*

Key Words*: GDM, Macrosomia,: Umbilical Cord Thickness, Umbilical cord cross sectional area*

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I. Introduction

The prevalence of Gestational Diabetes Mellitus (GDM) in India is about 21%.[1]Pregnancy causes physiological changes in maternal carbohydrate metabolism which is due to placental hormones, causing increase in insulin resistance and increased Diabetogenic stress[2]. GDM has been defined as carbohydrate intolerance which is first found during pregnancy[3], which necessitates compensatory increase in insulin secretion and when this compensation is not adequate it leads to development of gestational diabetes[4]. GDM has become the most common complication and most challenging threat to pregnant woman[5]. GDM cases have risk of developing maternal complications like polyhydramnios, Hypertension, PPH, Pre-eclampsia, and foetal complications like IUGR, macrosomia, stillbirth, polycythaemia, Heart &Respiratory distress syndrome[6]. Low APGAR is seen more in Macrosomia and IUGR babies in GDM[6]. Previous studies stated the relationship between the intra uterine growth and USG findings of umbilical cord parameters. So this study aimed to find out USG screening in GDM mothers and compare it with the birth outcome. These parameters should warn the physician in advance for close watch on pregnancy.

II. Aims And Objectives

- To Screen for GDM at second trimester of pregnancy.
- To assess the cases and controls radiologically at 30-32 weeks of pregnancy.
- To correlate the ultra-sonographic finding of umbilical cord parameters with the Birth outcome in Gestational DM in assessing the prognostic significance.
- Significance of Sonographic measurements of umbilical cord thickness and Cross Sectional area in normal pregnancy which is compared with that of Gestational DM to assess the pregnancy outcome at the time of delivery.

III. Material& Method

This study was started after obtaining approval from the Institutional Ethics Committee and informed consent from the cases & control group.

Study Design: Prospective observational Study.

Study Setting: Trichy SRM Medical College Hospital and Research Centre.

Study Population:GDM mothers who had regular antenatal check-up in Obstetric OPD.

Inclusion criteria: Both primi and multi gravida GDM cases who were screened for Oral Glucose tolerance test at 20-24 weeks of gestation were included in the study. Based on the WHO criteria or Carpenter and Coustan Criteria with75g of oral glucose given in Fasting state. Blood glucose estimation was done with Fasting blood glucose of≥95 mg/dl, 1hr≥180 mg/dl, 2hrs ≥155mg/dl.If ≥ 2 values are abnormal the patients were diagnosed as GDM. The age group between 20 to 40 years who attended the OG department OPD in the II Trimester for regular Antenatal check-up and recently delivered from rural area around the tertiary care hospital of low socio economic status were included in the study. Patients who gave consent to participate in the study were included.

Exclusion criteria: Pregnant women with severe anaemia, Twin pregnancy, overt Diabetes, Hypertension, Thyroid diseases and those who are not willing to participate, were excluded from the study.

Period of study: The study was completed within 1 year of duration.
Sample size: Group 1 consisting of 100 GDM cases & Group 2 consisting of 100controls which are normal pregnancies.

Data Collection and procedure:
A structured proforma was used to collect a socio demographic history consisting of anthropometric measurements like height, weight & BMI measured by standard methods. The pregnant women are screened for GDM by using WHO Criteria or Carpenter and Coustan Criteria using 75 gms of glucose given in Fasting state. The patients who have fasting blood glucose ≥95 mg/dl, 1 hour ≥ 185 mg/dl and 2hr ≥ 155mg/dl (≥ 2 values abnormal) were taken as cases (n=100) and 100 aged matched controls which were normal pregnancies were included. After which all women were subjected to Ultra sound between 30-32 weeks and Routine USG was performed by standard USG Scanner. The umbilical cord thickness and Cross sectional area were measured in floating loops of Umbilical cord using software in USG Unit. USG measured outer edges of umbilical cord by using elliptical calibrator. Three measurements were taken and an average value was calculated. The woman were followed up till the time of delivery to observe maternal and neonatal outcomes.
Classification according to birth weight:
Macrosomia ≥4.5 kg
IUGR ≤ 2.5 Kg

Ultra-sonographicparameters:
1) Umbilical cord thickness :Optimal threshold for umbilical cord thickness- >9.8mm
2) Umbilical cord Diameter:Optimal threshold for umbilical cord diameter - >66 m^2

Statistical Analysis: Pearson correlation &unpaired t-test were done using SPSS Software for windows.

IV. Results

In this study 100 GDM cases were compared to 100 age matched normal pregnancies as controls without any complications. Mean age of the cases was 28.5 ± 4.7 and mean age of the controls was 27.4 ± 3.5. Maternal complications were more prevalent in the GDM mothers (74%) when compared to the control group 20% showing a significant difference between the groups (p<0.005). Foetal complications were more in the GDM pregnancies (70%) when compared to control group (22%) showing significant difference (p<0.005).

Among the cases Macrosomia was 40% associated with low APGAR score. While in the control group only IUGR was the complication (10%).

The mean umbilical cord diameter for the cases and controls was 17 ± 5.0 mm and 14 ± 5.0 mm respectively and there was a significant difference between the two groups (p<0.005). Mean cross sectional area for the cases was 21 ± 5.0m^2 and controls was 17 ± 7.0 m^2. A significant difference was found between the two groups (p<0.005).The mean birth weight for cases and controls was 3.05 ± 0.6 Kg and 2.9 ± 0.5 Kg respectively which was statistically significant (p<0.005). Mean APGAR score was4.3 ± 2.3 for cases and 6.5 ± 1 for controls showing statistically significant difference between the two (p<0.005).Table 1

Table 1: Mean Parameters Cases and Controls.

	Umbilical Cord Thickness(mm)	Cross sectional Area (m^2)	Birth Weight(Kg)	APGAR Score
Cases	17.0 ± 5.0	21 ± 5.0	3.05 ± 0.6	4.3 ± 2.3
Controls	14.0 ± 5.0	17 ± 7.0	2.9 ± 0.5	6.5 ± 1.9
p Value	<0.005	<0.005	<0.005	<0.005

Pearson correlation was performed among the GDM cases and a statistically significant positive correlation was seen between birth weight and umbilical cord thickness (table value 0.100, Person correlation r= 0.556) umbilical cord cross sectional area (table value 0.100, Person correlation r= 0.598). While a statistically significant but negative correlation was found between Apgar score and umbilical cord thickness (table value 0.100, Person correlation r= -0.432) and umbilical cord cross sectional area (table value 0.100, Person correlation r= -0.413). Table 2

Table 2: Pearson Correlation for GDM Cases

USG Parameter	Pearson correlation		p value
	Birth weight Mean (3 ±1.5 kg)	5 min APGAR Score	
Cord Thickness	.556	-.432	0.005*
Cross Sectional Area	.598	-.432	0.005*

Pearson correlation was performed among the controls and a statistically significant positive correlation was seen between birth weight and umbilical cord thickness (table value 0.100, Person correlation r= 0.377) umbilical cord cross sectional area (table value 0.100, Person correlation r= 0.299). While a statistically significant but positive correlation was found between Apgar score and umbilical cord thickness (table value 0.100, Person correlation r= 0.492) and umbilical cord cross sectional area (table value 0.100, Person correlation r= 0.460).Table 3

Table 3: Pearson Correlation for Controls

USG Parameter	Pearson correlation		P value
	Birth weight Mean (2.5 ±1.5 kg)	5 min APGAR Score	
Cord Thickness	.377	.492	0.005*
Cross Sectional Area	.299	.460	0.005*

ROC Curve: (Receiver operating characteristic curve analysis)

As there is overlap between parameters ROC curve was plotted to find the optimal threshold of umbilical cord thickness and umbilical cord cross sectional area. Sensitivity and specificity were calculated. For Macrosomia with low APGAR score, the cut of or optimal threshold for umbilical cord Thickness was 18.1mm and area under the curve was .84 with a sensitivity of 88% and specificity of 73%. While the cut off for Umbilical cord cross sectional area was 235 mm sq with area under the curve .81 and sensitivity of 88% and specificity 74%.(Table 4, Figure 1 and 2).

Table 4: Summary of Parameters based on ROC Analysis for macrosomia with Low APGAR in Cases:

Sl. NO	Parameters	Area Under Curve	Cut Off Cl=95%	Sensitivity	Specificity
1	Umbilical Cord Thickness	.84	18.1	88%	73%
2	Umbilical Cord Cross Sectional Area	.81	235	88%	74%

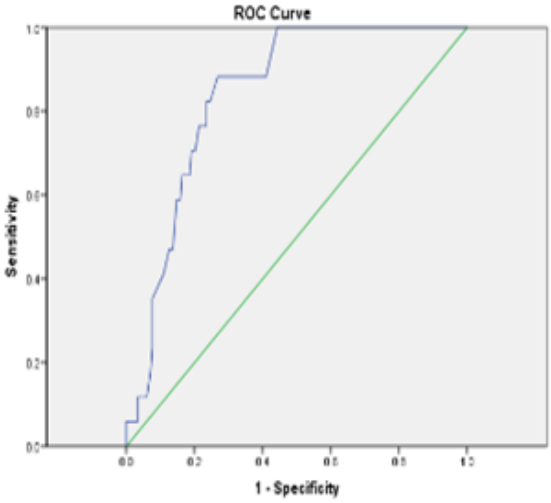

Figure 1: ROC Curve: Umbilical Cord Thickness in Macrosomia Having Low Apgar in Cases.

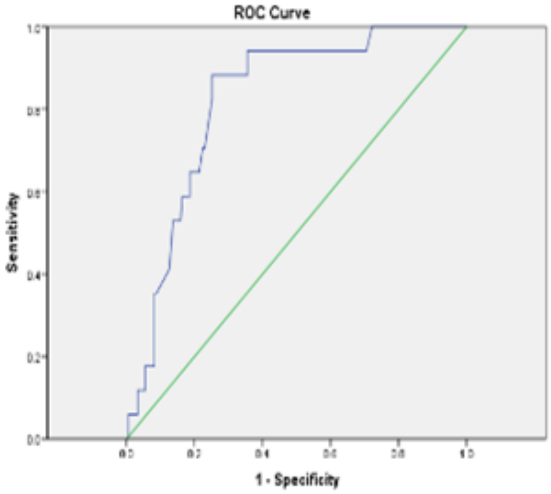

Figure 2: ROC Curve: Cross Sectional Area of Cord in Macrosomia Babies Having Low Apgar in cases.

For IUGR with low APGAR score, the cut of or optimal threshold for umbilical cord Thickness was 12.8mm and area under the curve was .78 with a sensitivity of 81% and specificity of 71%. While the cut off for Umbilical cord cross sectional area was 169mmsq with area under the curve was .79 and sensitivity was 77% and specificity of 73%. (Table 5, Figure 3 and 4).

Table 5: Summary of Parameters based on ROC Analysis for IUGR with Low APGAR among controls.

Sl. NO	Parameters	Area Under Curve	Cut Off CI=95%	Sensitivity	Specificity
1	Umbilical Cord Thickness	.78	12.8	81%	71%
2	Umbilical Cord Cross Sectional Area	.79	169	77%	73%

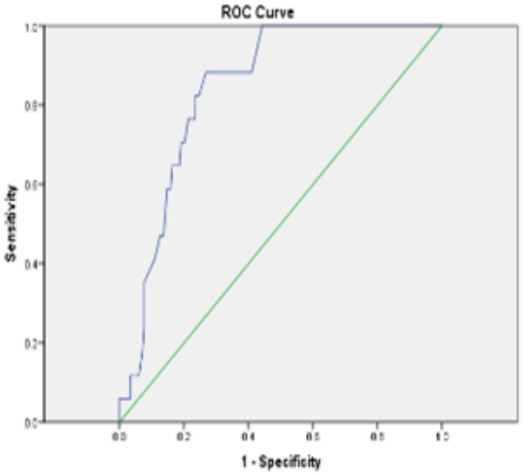

Figure 1: ROC Curve: Umbilical Cord Thickness in Macrosomia Having Low Apgar in Cases.

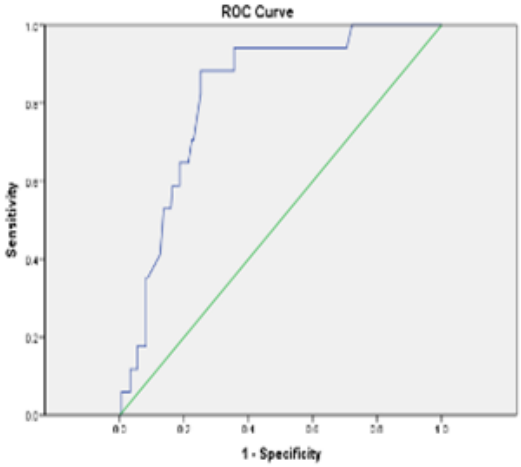

Figure 2: ROC Curve: Cross Sectional Area of Cord in Macrosomia Babies Having Low Apgar in cases.

Unpaired t test and person correlation test showed that umbilical cord thickness and cross sectional area were significantly related to APGAR and Birth weight.

V. Discussion

GDM is due impaired carbohydrate tolerance occurring in pregnancy due to physiological changes. There is maternal and foetal adverse outcome which is highly prevalent in India due to GDM. In our study the main foetal complications which were seen in the Case was Macrosomia 40% while IUGR was the complication in control group (10%). Both of which were associated with low APGAR score**.** The Umbilical cord can be easily demonstrated and assessed by conventional real time ultra sound. Grey scale USG is easily available which can be used for the measurement of umbilical cord thickness and cross sectional area[9]. These parameters help in prognostic evaluation of pregnancy and birth outcome and can be more helpful especially in rural areas[8].In our study we found there were increased maternal and foetal complication in GDM cases when compared to the control group. Statistically significant positive correlation was found between umbilical cord thicknesses, umbilical cord cross sectional area with birth weight. But had a negative correlation with Apgar score. Similar results was demonstrated in a study by Rakesh et.al[10] In the control group a significant positive correlation was found between umbilical cord thickness, cross sectional area with birth weight and APGAR score.Umbilical cord thickness depends on luminal diameter and amount of Wharton's jelly[9]. As a matter of fact the umbilical cord thickness peaks at 32-36 weeks after which it plateaus[10].

Though we recognize the importance of umbilical cord and assess the umbilical cord parameters like number of vessels and the resistance to blood flow, Features like any umbilical anomalies, twisting of cord, umbilical cord thickness and cross sectional area are usually incidental findings. Pulse Doppler analysis and resistance to blood flow show a direct picture of the placental function which is checked routinely. But features like umbilical cord thickness and cross sectional area are been ignored which have a direct correlation with birth weight and low apgar score[8]. Many studies show that cord thickness and amount of wharton's jelly excessive or deficient could be useful in evaluation of various clinically adverse antenatal and perinatal outcomes[8].

Maternal hyperglycaemia leads to foetal hyperglycaemia leading to increased foetal growth and Macrosomia the consequence of which are foetal complications like obstructed labour, shoulder dystocia, brachial plexus injury, meconium aspiration syndrome, respiratory distress syndrome and low APGAR score[11].The only way to avoid these complications is predicting the adverse birth outcome earlier and planning management of GDM. To predict the birth weight and low APGAR prior is by measuring the umbilical cord thickness and cross sectional area shown by studies done by Weismann et.all[12].In GDM there is erosion of endothelial lining of the umbilical artery causing increase in permeability and therefore there is leak of plasma proteins leading to expiation of ground substance and increase of wharton's jelly. Which is the reason for a thicker umbilical cord and Macrosomia. While sometimes due insulin resistance, there is development of a thin umbilical cordin GDM leading to IUGR[7].

Umbilical cord thickness and cross sectional area have a correlation with birth weight was shown in studies by Binbir[13]. While no significant correlation was shown by Predanic[14].Strong correlation between umbilical cord thickness and cross sectional area was shown in a study on GDM and macrosomia giving a value of 20.1mm and 239.7mmsqat 30-34 weeks[11]. While our study showed values of 18.1mm and 238mmsq.Further

in a study optimal threshold for low birth weight and IUGR with a low APGAR was given as 9.8mm for umbilical cord thickness and 66mmsq for umbilical cord cross sectional area[8]. In our study the result for the same was 12.8mm and 169mmsq.

Thus according to our study the Range of umbilical cord thickness is ≥12.8mm to ≤18.1mm and umbilical cord cross sectional area of ≥169mmsq and ≤238mmsq estimated have a good pregnancy outcome. Below which may have an outcome of IUGR and above which Macrosomia was seen. We propose from our study that umbilical cord thickness and cross sectional area should be looked upon at 30-32 weeks along with the routine USG parameters which may add extra 5 to 10 minutes but give a direct picture of the pregnancy outcome.

VI. Conclusion

There is high prevalence of Gestational DM in India so timely planning and management is very necessary to prevent adverse birth outcome. After screening and diagnosis of GDM intervention should be started and we propose that while taking routine ultrasound scan umbilical cord thickness and umbilical cord cross sectional area should be measured which is easy and can be finished within a short span of few minutes and are predictors of Birth outcome. There is a strong correlation between IUGR, APGAR and umbilical cord thickness and cross sectional area which should warn the physician to keep a close watch and plan appropriate management.

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