Correlational study of birth weight to sonographic measurement of umbilical cord thickness, fetal abdominal and shoulder pad thickness in overt and gestational diabetes mellitus

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Abstract

Introduction: Diabetes is the most common medical complication of pregnancy. Ultrasound has a major role antenatally in predicting fetal weight by using subcutaneous tissue thickness. Hence the major complication macrosomia can be tackled ideally.

Materials and Methods: 100 patients found to have diabetes mellitus, were send for antenatal scan between 30 to 35 weeks and umbilical cord thickness (UC), fetal abdominal subcutaneous tissue thickness (ASTT) and subscapular subcutaneous tissue thickness (SSTT) are measured. They were followed up to delivery and the baby birth weight was recorded to correlate with the sonographic measurements.

Results: SSTT and ASTT measurement had statistically significant correlation with birth weight with a 'p value' of <0.001.

Conclusion: Soft tissue thickness specially SSTT and ASTT can be used to predict macrosomia; hence complications due to that can be properly tackled.

Keywords: ASTT, SSTT, Umbilical cord thickness.

Introduction

Diabetes is the most common medical complication of pregnancy. Women can be separated into those who were known to have Diabetes before pregnancy- pregestational or overt; and those diagnosed in pregnancy- gestational diabetes.[1]

Pregestational Diabetes: The increasing incidence of type 2 diabetes in general, and in younger people in particular have led to an increasing number of affected pregnancies. The number of pregnant women with diabetes that was undiagnosed before pregnancy is increasing. In fact 5 to 10% of women with gestational diabetes are found to have diabetes immediately after delivery. Women with a random plasma glucose level> 200mg/dl plus clinical signs and symptoms such as polydipsia, polyuria and unexplained weight loss or those with a fasting glucose level > 125mg/dl are considered by the American Diabetes Association(ADA ; 2012) to have overt diabetes.[2,3] To diagnose overt diabetes in pregnancy, the International Association of Diabetes and Pregnancy Study Groups(IADPSG) recommends threshold values for fasting or random plasma glucose and glycosylated haemoglobin (HbA1c) level at prenatal care initiation. Risk factors for overt diabetes include a strong family history of diabetes mellitus, prior delivery of a large baby, persistent glucosuria or unexplained fetal losses.[2,3] They can experience serious complications directly attributable to diabetes. The outcome depends on the glycemic control. Fetal effects are spontaneous abortion, preterm delivery, malformations, altered fetal growth, unexplained fetal demise, hydramnios, neonatal morbidity, respiratory distress syndrome, hypoglycemia, hypocalcemia, hyperbilirubinemia, polycythemia, cardiomyopathy, long term cognitive development, inheritance of diabetes.[4-7] Major maternal complications are preeclampsia, diabetic nephropathy, diabetic retinopathy, diabetic neuropathy, diabetic ketoacidosis, infections.

Gestational Diabetes: The word gestational diabetes implies that diabetes is induced by pregnancy- ostensibly because of exaggerated physiological change in glucose metabolism. Gestational diabetes is defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy. More than half of women with gestational diabetes ultimately develop overt diabetes in the ensuing 20 years.[8,9] The recommended screening 2 step approach begins with either universal or risk based selective screening using 50gm 1 hour oral glucose challenge test. Universal screening is also acceptable. Screening should be performed between 24 and 28 weeks gestation in those women not known to have glucose intolerance earlier in pregnancy. This 50gm screening test is followed by a diagnostic 100gm 3 hour oral glucose tolerance test (OGTT) or by 75gm 2 hour OGTT [10.] If screening results meet or exceed a predetermined plasma glucose concentration. For the 50 gm screen, the plasma glucose level is measured 1 hour after a 50gm oral glucose load without regard to the time of day or time of last meal. The threshold is kept as 140mg/dl. OGTT is performed after overnight fasting. 75gm OGTT threshold is >100mg/dl fasting and 140 to 198mg/dl 2 hours value. 100gm OGTT threshold is 95/180/155/140. If any 2 values are abnormal, then it is diagnostic of gestational diabetes. Women in the intervention group had a significantly reduced risk of a composite adverse outcome that included perinatal mortality, shoulder dystocia, fetal bone fractures and fetal nerve palsy. Macrosomia is defined as > 4000gm. It occurs in 10% cases. Mild gestational diabetes can be identified by fasting glucose level > 95mg/dl.[11] There is an increased risk of unexplained

fetal demise. The ADA concluded that fasting hyperglycemia > 105mg/dl may be associated with an increased risk of fetal death during final 4 to 8 weeks. There is an increased association with gestational hypertension and cesarean delivery. Fetal macrosomia>4 kg baby weight is directly associated with maternal hyperglycemia. Maternal hyperglycemia induces fetal hyperinsulinemia, particularly during the 2nd half of pregnancy. It is associated with fetal hypoglycemia, maternal obesity etc.[12] These group of pregnant patients are recommended a 75g OGTT 6 to 12 weeks postpartum for the diagnosis of overt diabetes mellitus[13]

Materials and Methods
Methods of data collection:
Test done to select patients- (any of the following)
1. 24 to 28 week 50gm OGCT with value >200mg/dl
2. 75gm GTT with any 1 abnormal value
3. 100gm GTT with any 2 abnormal value
4. RBS> 200mg/dl
5. FBS> 125mg/dl
6. HbA1c>6.5%
7. Known case of diabetes mellitus

The patient falling in the above mentioned criteria, when send for routine antenatal scan in 3rd trimester (between 30 to 35 weeks) are additionally looked for umbilical cord thickness, fetal abdominal subcutaneous tissue thickness (ASTT) and subscapular subcutaneous tissue thickness (SSTT). Then these patients are followed up to delivery and the baby birth weight is recorded to correlate with the sonographic measurements.

(i) **Measurement of Umbilical Cord Thickness (UC):** Measure the umbilical cord and vessels near its entrance into the fetal abdomen in the long axis view. Average of 3 such measurements are taken. The Wharton jelly content of the cord is estimated by calculating its surface area by subtracting the area of vessels from the total cord surface area.

(ii) **Measurement of ASTT:** Thickness of the anterior abdominal subcutaneous tissue on the same axial image as that used for AC (abdominal circumference).

(iii) **Measurement of SSTT:** The fetus is imaged in a naturally prone or lateral posture, as far as possible, so the entire scapula is seen. The caliper is positioned between the skin surface and the subcutaneous tissue at the interface, perpendicular to the lowest end of the scapula.
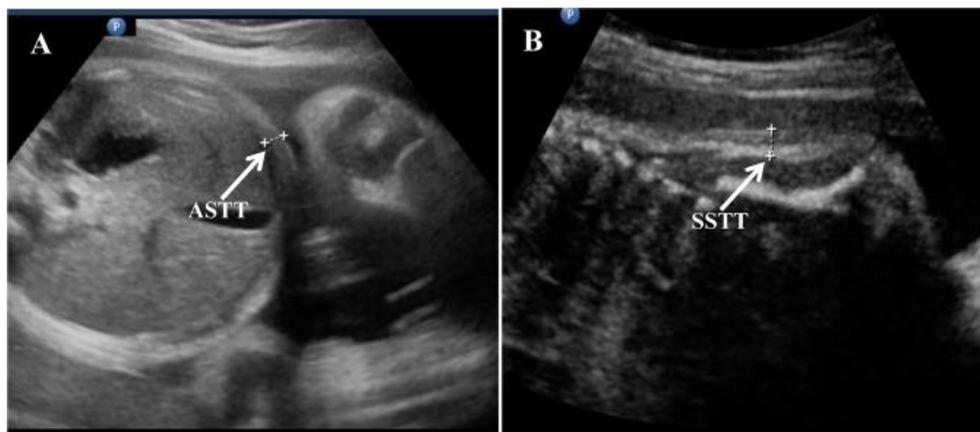

Fig. 1A: ASTT (Abdominal subcutaneous tissue thickness); B: SSTT (Subscapular tissue thickness)

Inclusion Criteria
1. Overt Diabetic pregnant ladies
2. Gestational Diabetes mellitus
Exclusion Criteria
1. Multiple pregnancy
2. Pregnancy complicated with hypertension or any other systemic illness
3. Obese patients
4. Drop outs due to referral or IUD
Sample Size: A total of 100 antenatal patients who are detected to have diabetes are included in the study.
Sample size calculated using the formula;

$$n = \frac{Z^2_{1-\alpha/2} \times p(1-p)}{d^2}$$

Where Z is static corresponding to level of confidence; =1.96 is a constant; p is prevalence. Probability of type 1 error

(α) is taken as 0.05; d is precision. Out of 3104 total deliveries in 2015 there were 1051 diabetic cases in Jubilee Mission Medical College Thrissur.

Statistical Methods
The data was entered in Microsoft Excel spread sheet. All the data obtained were evaluated using SPSS (IBM, Chicago, Illionis, USA) Windows 20.0 statistical software. Significance is assessed at 5% level of significance.

Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, non-parametric setting for Qualitative data analysis. Fisher exact test used when samples are very small. Statistical significance was set to $p < 0.05$.

Results

Out of the 100 subjects studied there were 30 babies in 2.5 to 2.99kg group, 39 in 3 to 3.49kg group, 19 in 3.5 to 3.99kg group and 12 belonged to ≥4kg group. Majority were in the 3 to 3.49kg group (39%). Average birth weight is 3.31kg.

There were 24 overt diabetics and 76 GDM patients in the study.

Among the babies born 5 were preterm births out of which 2 were born at 35 weeks and 3 were born at 36 weeks. The other 95 babies were term; in which 34 were born at 37 weeks, 44 were at 38 weeks, 15 at 39 weeks and 2 were at 40 weeks. Majority of the births were at 38 completed weeks (44%).

In the ultrasonographic soft tissue measurements; ASTT measurement (in mm) 12 belonged to < 3mm group; 72 belonged to 3 to 5mm group; and 16 in >5mm group. Majority were in 3 to 5mm group (72%). In the SSTT measurement (in mm) 16 belonged to < 3mm group; 58 belonged to 3 to 5mm group; and 26 in >5mm group. Majority were in 3 to 5mm group (58%). In the UC measurement (in cm^2) 48 belonged to < 1.5 cm^2 group; 48 belonged to 1.5 to 2.5cm^2 group; and 4 in >2.5cm^2 group.

Table 1: ASTT/SSTT/UC distribution in relation to Birth weight of neonates studied

Variables		Birth weight			Total	P value
	2.5-2.99 kg	3.0-3.49 kg	3.5-3.99 kg	≥4kg	n=100)	
	(n=30)	(n=39)	(n=19)	(n=12)		
ASTT (mm)						
<3	23.3	12.8	0	0	12	<0.001**
3-5	76.7	87.2	57.9	33.3	72	
>5	0	0	42.1	66.7	16	
SSTT (mm)						
<3	43.3	7.7	0	0	16	<0.001**
3-5	56.7	92.3	26.3	0	58	
>5	0	0	73.7	100	26	
UC (cm^2)						
<1.5	50	59	26.3	41.7	48	0.081+
1.5-2.5	50	38.5	57.9	58.3	48	
>2.5	0	2.6	15.8	0	4	
Chi-Square/Fisher Exact Test						

The soft tissue measurements of ASTT and SSTT have a strong statistical correlation with the birth weight with p value < 0.001. And there is only a suggestive significance between the umbilical cord thickness and the birth weight with a p value of 0.081

Conclusion

As the incidence of Diabetes Mellitus complicating pregnancy (both overt DM and GDM) is on the rise, macrosomia has to be detected early and tackled in time as it poses problems to both the mother and the baby. In our study, among the ≥4kg babies 75% of them were born at 38 weeks of gestation and 25% were born at 39 weeks of gestation. There was significant correlation between the gestational age at birth and with the birth weight. Also, we found that there is strong statistical correlation between the soft tissue measurements by ultrasound like ASTT (abdominal subcutaneous tissue thickness) and SSTT (subscapular subcutaneous tissue thickness) with the birth weight of the baby. However such a strong correlation could not be established between umbilical cord thickness and the birth weight. Hence ASTT and SSTT can be used to predict macrosomia antenatally.

Conflict of Interest: None.

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