Estimation of Sonographic Umbilical Cord Area and Its Correlation with Birth Weight in Gestational Diabetes Mellitus.

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Keywords: Umbilical Cord, Umbilical Cord Area, Gestational Diabetes Mellitus, Macrosomia.

ABSTRACT

Background: Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance with its onset or first recognition during pregnancy. It is associated with various maternal and fetal complications of which, macrosomia is the major challenging threat. Prediction of birth weight helps in timely decision and management of these women. A recent way to predict birth weight is by umbilical cord area estimation.

Methods: A prospective cohort study including 50 women with GDM (group I) and 50 without GDM (group II) was conducted in a tertiary hospital over a period of 1 year, after clearance from Institutional Ethical Committee. Women in both groups were subjected to ultrasonographic examination at 30-32 weeks and subsequently at 36-38 weeks. At each examination, umbilical cord area (UCA) was measured in a free loop of umbilical cord. Birth weight of each baby was measured.

Results: At 30-32 weeks, UCA was 239.7 mm² in group I and 224 mm² in group II, difference being statistically significant. At 36-38 weeks also, UCA was significantly larger in group I (250.1 mm²) than in group II (228.2 mm²). Correlation coefficient (r) between umbilical cord area and birth weight was 0.944 in group I and 0.796 in group II at 30-32 weeks and at 36-38 weeks, 0.990 in group I and 0.530 in group II.

Conclusions: A strong positive correlation exists between umbilical cord area and birth weight in women with gestational diabetes mellitus, thus it should be estimated during routine antenatal ultrasound for prediction of birth weight in these women.

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Introduction
Diabetes, one of the most common medical complications, has become a major challenging threat in a pregnant woman. The prevalence of gestational diabetes mellitus in India varies from 3.8% to 21%.

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance with its onset or first recognition during pregnancy. It is associated with various maternal and fetal complications which include polyhydramnios, macrosomia, operative interference, shoulder dystocia, birth injuries and perinatal mortality. Of all these, one of the major complication effecting both mother and fetus is macrosomia. Macrosomia is defined as gestational age adjusted birth weight >90th percentile of reference population or as birth weight ≥4.0kg. However, American college of obstetrics & gynaecology (2000) defines it as birth weight ≥4.5kg. Incidence of macrosomia is around 1-10%. So, one of the most important perinatal goals in GDM is to predict macrosomia by estimating birth weight, thereby preventing the adverse maternal and fetal outcomes.

Umbilical cord area: A recent way to predict birth weight is by sonographic estimation of umbilical cord area (UCA). Umbilical cord is made up of three vessels i.e. two arteries and one vein, which are embedded in Wharton’s jelly. It can be classified as:

1. Lean: UCA is below 10th percentile for gestational age. It is seen in conditions such as tobacco smoking, prematurity, hypertensive disease and fetal growth restriction.
2. Large: UCA is above 90th percentile for gestational age. It is found in Gestational diabetes mellitus, fetal structural anomalies like urachal cyst, omphalomesentric cyst and umbilical cord tumor.

Material and Methods
This prospective cohort study was carried out in the department of Obstetrics and Gynaecology in a tertiary hospital over a period of one year after clearance from Institutional ethical committee.

Inclusion criteria: were women with singleton pregnancy, with GDM and who gave consent for participation in the study.

Exclusion criteria: included multiple gestation, obstetrical complications such as preeclampsia, intrauterine growth restriction, oligohydramnios, hydrops, fetal congenital malformations, maternal chronic diseases such as overt diabetes, hypertension, renal diseases, cardiac diseases and pulmonary diseases, history of smoking and alcohol, women who were not sure of date of Last menstrual period/did not have first trimester ultrasound and those who did not give consent for participation in the study.

Women with singleton pregnancy at 24-28 weeks of gestation, who fulfilled the inclusion criteria, were enrolled from the antenatal clinic. A written informed consent was taken. After detailed history and examination, all women were screened for GDM by 50 grams GCT. In women with GCT ≥140 mg%, 100grams GTT was done. GDM was diagnosed on the basis of Carpenter and Coustan criteria. 50 women with GDM were included in group I and 50 women with normal GCT were enrolled in group II. All women were subjected to ultrasonographic examination at 30-32 weeks and subsequently at 36-38 weeks.

Umbilical cord area was measured in a free loop according to the method used by Binbir et al. UCA was measured around outer edges of umbilical cord by using elliptical calibrators (Figure 1). 3 measurements were taken and average value was calculated. Women were followed till the time of delivery to observe maternal and neonatal outcomes. Birth weight of baby was measured. Macrosomia was defined as birth weight ≥4kg.

Data analysis: Data was compiled and analyzed by using SPSS software. p value <0.05 was considered significant.

Results
The mean maternal age in women with GDM, group I (27.8 years) was comparable to that in group II (27.2 years). However maternal weight was higher in group I than in group II, difference being statistically significant. In both groups, 45 (90%) women were multigravida while 10% were primiparous. Bad obstetric history in term of history of abortions, IUD, big size baby and GDM in previous pregnancies was present in 48%, 20%, 4% and 16% women respectively in group I. Out of 50 women with GDM in group I, 35 (70%) were controlled on diabetic diet only while 15 (30%) women required insulin for glycaemic control.

Among mode of delivery, it was found that in group I, 66% women delivered vaginally, of which 8% had instrumental vaginal delivery and 34% had caesarean section. Caesarean rate was found to be much lower in group II (16%).

*Carpenter & Coustan criteria: Fasting ≥95 mg/dl, 1 hour ≥180 mg/dl, 2 hours ≥155 mg/dl, 3hours ≥140 mg/dl. If ≥2 values are abnormal, woman is diagnosed as GDM.
The mean birth weight was significantly higher in group I (3.15 kg) than in group II (2.90 kg). 5 babies (10%) were found to be macrosomic, all belonging to group I. However, no significant difference was found in terms of low Apgar score, birth asphyxia, need of ventilation and neonatal death among two groups.

During ultrasonographic examination at 30-32 weeks, it was found that at 30-32 weeks, UCA was 239.7 mm² in group I and 224 mm² in group II, difference being statistically significant. At 36-38 weeks, UCA was significantly larger in group I (250.1 mm²) than in group II (228.2 mm²). Hence, UCA was significantly greater in women with GDM at both the gestations. Estimation value of Umbilical cord area is shown in Table 1.

Correlation coefficient was calculated to see degree of correlation between UCA and birth weight. It was found that in group II, a weak correlation exists between UCA and birth weight at both 30-32 weeks (r = 0.796) and 36-38 weeks (r = 0.530). However, in group I (women with GDM), a significant positive relationship was found between umbilical cord area and birth weight at both 30-32 weeks (r = 0.944) and 36-38 weeks (r = 0.990).

Thus, although a positive linear relationship exists between UCA and birth weight in both the groups at both gestations but the correlation is much stronger in women with GDM (Figure II, III, IV, V).

Discussion

Gestational diabetes mellitus is associated with various maternal and fetal complications. Maternal hyperglycaemia leads to development of fetal hyperglycaemia, thus excessive fetal growth, thereby leading to Macrosomia. Macrosomic babies cause multiple complications during vaginal delivery including shoulder dystocia, brachial plexus injury, meconium aspiration, respiratory distress and low Apgar score. So, to avoid these complications, prediction of birth weight is to be done for timely decision and better management of women with GDM.

One of the parameter to predict birth weight is umbilical cord area. Weismann et al conducted a study in 368 uncomplicated pregnancies and found that UCA increases with gestational age till it reaches a peak at 36 weeks of gestation and plateau thereafter. Various studies have observed this peak of UCA at varying gestational age ranging from 32-34 weeks. In the present study also, we found that in women without GDM (group II), UCA was comparable at 30-32 weeks (224.0 mm²) and 36-38 weeks (228.8 mm²). However, in group I, a significant increase was found from 30-32 weeks (239.7 mm²) to 36-38 weeks (250.1 mm²), showing that in women with GDM, UCA increases significantly with advancing gestational age.

In the present study, fetus of women with GDM was found to have larger umbilical cord area than women without GDM. The proposed mechanism of this larger UCA is that in women with GDM, erosion of endothelial lining of umbilical arteries occurs. This leads to increased permeability with leakage of plasma proteins, causing an expansion of ground substance and thus, increases in area of Wharton’s jelly umbilical cord as given in study by Weismann et al.
Fig. III: Scatter diagram showing correlation between UCA and birth weight in group II ($r = 0.796$) at 30-32 weeks.

Fig. IV: Scatter diagram showing correlation between UCA and birth weight in group I ($r = 0.990$) at 36-38 weeks.

Fig. V: Scatter diagram showing correlation between UCA and birth weight in group II ($r = 0.530$) at 36-38 weeks.
A significant positive relationship was found between UCA and birth weight at both 30-32 weeks ($r = 0.944$) and 36-38 weeks ($r = 0.990$) in women with GDM. The results were in accordance with study by Binbir et al in which a statistically significant correlation was found between umbilical cord area and fetal weight in diabetic group at 36-37 weeks. However in a retrospective study by Predanic et al, done in 470 women, in which umbilical cord diameter was measured at gestation of 18-23 weeks, no significant correlation was found between umbilical cord diameter and birth weight ($p = 0.332$).

**Conclusion**

In conclusion, a significant positive correlation exists between sonographically estimated umbilical cord area and birth weight in women with gestational diabetes mellitus. Hence, Umbilical cord area should be estimated during routine antenatal ultrasound for prediction of birth weight in women with gestational diabetes mellitus.

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None

**Competing Interests**

None declared.

**References**


Table 1: Measured value (Mean) of umbilical cord area in group I and group II at 30-32 weeks and 36-38 weeks.

<table>
<thead>
<tr>
<th>Period of gestation</th>
<th>UCA in Group I (mm²)</th>
<th>UCA in Group II (mm²)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-32 wks</td>
<td>239.7</td>
<td>224.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>36-38 wks</td>
<td>250.1</td>
<td>228.8</td>
<td>&lt;0.001</td>
</tr>
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</table>

**Abreviations**

<table>
<thead>
<tr>
<th>GDM</th>
<th>Gestational diabetes mellitus</th>
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<tbody>
<tr>
<td>UCA</td>
<td>Umbilical cord area</td>
</tr>
<tr>
<td>GCT</td>
<td>Glucose challenge test</td>
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<tr>
<td>GTT</td>
<td>Glucose tolerance test</td>
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