A Comparative Study between Umbilical Cord Area and Abdominal Circumference to Predict Macrosomia in Gestational Diabetes Mellitus

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Abstract

Aim: Comparison of umbilical cord area with abdominal circumference to predict macrosomia in women with gestational diabetes mellitus.

Methods: A prospective cohort study including 50 women with gestational diabetes mellitus (GDM) and 50 women without GDM was conducted at 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 to measure abdominal circumference (AC) and umbilical cord area (UCA). UCA was measured in a cross sectional plane in free loop of umbilical cord. All women were followed till delivery. Birth weight of each baby was measured. Birth weight ≥4.0 kg was considered as macrosomia.

Results: Accuracy of 95th centile of AC and UCA was compared. It was found that although AC was 99% accurate but UCA was 100% accurate in predicting macrosomia at both the gestations.

Conclusions: Umbilical cord area is a better predictor of macrosomia than abdominal circumference in women with GDM.

Keywords: abdominal circumference, gestational diabetes mellitus, macrosomia, umbilical cord, umbilical cord area.

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%[1-8].

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, 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[9] of macrosomia is around 1-10%. Macrosomia itself is associated with number of various maternal and fetal complications like sudden intrauterine demise, shoulder dystocia, neonatal injuries, maternal perineal injuries and neonatal mortality.

One of the most important concerns in macrosomia is to decide mode of delivery, whether to do elective caesarean section or conduct vaginal delivery. On one side, doing caesarean section for baby who could have been delivered

vaginally leads to poor obstetrical outcome in future pregnancy while on other side; conducting vaginal delivery in large babies can lead to maternal and neonatal morbidities as well as neonatal mortality.

Thus, the obstetricians need to be 100% accurate in determining macrosomia in women with GDM. Hence this study was conducted to find more precise predictor of macrosomia in women with GDM for better obstetrical management.

Material and Methods

This prospective cohort study was carried out in the department of Obstetrics and Gynaecology at tertiary hospital over a period of one year. After clearance from Institutional ethical committee, this study was conducted.

Inclusion criteria were women with singleton pregnancy, with GDM and who gave consent for participation in 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 and women who were not sure of date of Last menstrual period/did not have first trimester ultrasound.

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 (without GDM) were enrolled in group II.

All women were subjected to ultrasonographic examination at 30-32 weeks and subsequently at 36-38weeks. The sonographic examination was performed using HDI ATL- 5000 model with 3.5-5.0MHz convex broad based transducer. At each examination, abdominal circumference and umbilical cord area was measured.

Abdominal circumference (AC) was measured in a circular plane at the level of liver and stomach, including left portal vein at umbilical region by focusing first long axis of fetus through longitudinal section along fetal spine and aorta and then rotating the transducer by 90^0 to obtain transverse plane. The correct section shows umbilical vein most centrally as it enters the portal system.

Umbilical cord area (UCA) was measured in a free loop according to the method used by Binbir[10] et al. It was measured around outer edges of umbilical cord by using elliptical calibrators. 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 each baby was measured. Macrosomia was defined as birth weight ≥4kg.

Data was compiled and analyzed by using SPSS software. p value <0.05 was considered significant. Sensitivity and specificity of both the parameters was calculated to determine diagnostic accuracy.

> ***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.

Results

Among demographic profile, mean maternal age of enrolled women in 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 (table I).

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.

As shown in table II, AC was found to be larger in group I (27.1 cm) than in group II (26.2 cm), difference being statistically significant at 30-32 weeks. At 36-38 weeks, AC was again significantly larger in group I (33.7 cm) than in group II (33.1 cm). However, the increase in abdominal circumference from 30-32 weeks to 36-38 weeks was not significantly higher in group I than in group II.

Umbilical cord area was 23.9 cm^2 in group I and 22.4 cm^2 in group II at 30-32 weeks, difference being statistically significant. Subsequently at 36-38 weeks, UCA was significantly larger in group I (25.0 cm^2) than in group II (22.8 cm^2). In group II, it was observed that increase in UCA from 30-32 weeks to 36-38 weeks was not significant while in group I, umbilical cord area found to be increased significantly with the advancing gestation.

Among maternal outcome, it was observed that 66% women in group I and 84% in group II delivered vaginally, difference being statistically insignificant. So, caesarean rate was higher in group I (34%) than in group II (16%). 8% women in group I had instrumental delivery. Elective caesarean section for good size baby was done in total 5 women (4 in group I, 1 in group II), out of which only 2 (in group I) had macrosomia.

Among neonatal outcome, the mean birth weight was significantly higher in group I (3.15 kg) than in group II (2.90kg). 5 babies (10%) were macrosomic, all belonging to group I (Fig II). Among neonatal outcomes measured as Apgar score, birth asphyxia, need of ventilation and neonatal death, no statistically significant difference was found between two groups.

Sensitivity and specificity of both AC and UCA was calculated and comparison was done on the basis of their diagnostic accuracy (Table III).

At 30-32 weeks, at cut off value of ≥90th percentile, AC (28.2 cm) had high accuracy (94%) with sensitivity of 100% and specificity of 93.7% to predict macrosomia. UCA (24.5 cm^2) had similar accuracy of 93% with 100% sensitivity and 92.6% specificity. However, at 36-38 weeks, UCA (26.09 cm^2) was found to have highest diagnostic accuracy of 95%.

Also, when cut off was placed at 95th centile, AC was found to have 99% accuracy with sensitivity of 100% and specificity of 98.9% at both 30-32 weeks and 36-38 weeks, but UCA (25.0 cm^2 at 30-32 weeks and 27.5 cm^2 at 36-38 weeks) was found to be 100% accurate in predicting macrosomia at both the gestations.

Discussion

This study shows that fetus of women with GDM has larger umbilical cord area and it increases as the gestation advances. 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, thereby increasing the area of umbilical cord.

Weismann[11] 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[12,13] have observed peak of UCA at varying gestational age ranging from 32-34 weeks. In the present study also, UCA was found to be comparable at 30-32 weeks (22.4 cm^2) and 36-38 weeks (22.8 cm^2) in group II. However, in group I, a significant increase was found from 30-32 weeks (23.9 cm^2) to 36-38 weeks (25.0 cm^2), showing that with

advancing gestational age, UCA increases significantly in women with GDM.

At cut of value of 90th percentile, abdominal circumference was found to be 94% accurate at 30-32 weeks and 93% accurate at 36-38 weeks to predict macrosomia. The results were in accordance with various studies[14,15,16] in which AC was found to be the most reliable parameter to predict macrosomia.

Macrosomia was found in 10% women in group I and UCA found to be ≥95th percentile in all of these fetuses at both 30-32 weeks and 36-38 weeks gestation, thus making it 100% accurate in predicting macrosomia. However, in study by Chromi[17] et al, done in 1026 women at 37.3 ± 2.1 weeks, UCA ≥95th centile was found to have sensitivity of only 54.7% with 91.3% specificity. This discrepancy could be because of small sample size in the present study.

Conclusion

Umbilical cord area has been found to be a precise predictor of macrosomia in women with gestational diabetes mellitus. Hence, this study recommends that while estimating fetal anthropometric parameters during routine antenatal ultrasound, area of umbilical cord should also be measured for better prediction of birth weight in women with gestational diabetes mellitus.

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TABLES

Table I: Demographic profile of women in group I and group II.

	Group I	Group II
H/o IUD	10 (20%)	5 (10%)
H/o big size baby	2 (4%)	0 (0%)
H/o GDM	8 (16%)	2 (4%)

Table II: Measurement value (Mean) of abdominal circumference and umbilical cord area in group I and group II.

	30-32weeks		P value	36-38 weeks		P value
	Group I	Group II		Group I	Group II	
AC (cm)	27.1	26.2	<0.001	33.7	33.1	<0.001
UCA (cm^2)	23.9	22.4	<0.001	25.0	22.8	<0.001

Table III: Diagnostic Accuracy of abdominal circumference and umbilical cord area at 30-32weeks and 36-38 weeks at ≥90th percentile and ≥95th percentile.

	At 30-32wks			At 36-38wks		
	Sn	Sp	accuracy	Sn	Sp	accuracy
At ≥90th percentile						
AC	100%	93.7%	94%	100%	92.6%	93%
UCA	100%	92.6%	93%	100%	94.7%	95%
At ≥95th percentile						
AC	100%	98.9%	99%	100%	98.9%	99%
UCA	100%	100%	100%	100%	100%	100%

Table I: Demographic profile of women in group I and group II.

	Group I	Group II
Age	27.8 yrs	27.2 yrs
Weight	58.8 kg	52.2 kg
GRAVIDITY G1	5 (10%)	5 (10%)
G2-3		
G4-5	41(82%)	41(82%)
	4 (8%)	4 (8%)
H/o abortions	24 (48%)	23(46%)