ORIGINAL ARTICLE

Role of Ultrasonographic Placental Thickness in Prediction of Fetal Outcome: A Prospective Indian Study

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Abstract

Background Information Placenta is the connecting organ between the mother and the fetus. It supplies oxygen and all the necessary elements for the growth and development of the fetus. In normal pregnancy, the growth of the placenta remains concordant with the growth of the fetus. The sonographic assessment of placenta can give information about the nutritional status of the fetus. It is known that normal placental thickness approximately equals gestational age. It is historically documented that placental weight is one-fifth of the fetal weight and abnormally thin or thick placenta is associated with increased incidence of perinatal morbidity and mortality. However, there are very few studies correlating placental thickness with Neonatal outcome.

Objectives To correlate ultrasonographic placental thickness at 32 and 36 weeks pregnancy with neonatal outcome. To propose placental thickness as a simple test for prediction of neonatal outcome.

Methods Placental thickness at 32 and 36 weeks was measured by ultrasound, in 130 pregnant mothers with confirmed dates and uncomplicated singleton pregnancy. Placental thickness was categorized as normal (10th–95th percentile), thin (<10th percentile) and thick (>95th percentile) at each stage and was correlated with birth weight and neonatal outcome.

Results Neonatal outcome was good in women with normal placental thickness (10th–95th percentile) at 32 and 36 weeks and was compromised in women with thin (<10th percentile) and thick (>95th percentile) placentae.

Conclusion Placental thickness at 32 and 36 weeks corresponds well with gestational age and is a good prognostic factor in assessing neonatal outcome. Therefore, placental thickness should be measured in addition to biometric parameters in antenatal women undergoing ultrasound.

Abbreviations

VMMC	Vardhman Mahavir Medical College
BMI	Body mass index
LSCS	Lower segment cesarean section
NICU	Neonatal intensive care unit
PC-PNDT Act	Pre-conception and Prenatal Diagnostic Techniques Act
mm	Millimeter
CNS	Central nervous system
ANC	Antenatal clinic
ITP	Immune thrombocytopenic purpura

Introduction

A healthy baby at term is the product of three important factors: a healthy mother, normal genes, and good placental implantation and growth. The placenta is the most important but unfortunately often ignored organ. A normally functioning placenta is required for normal fetal growth and development. It has been historically documented that placental weight in a normal pregnancy at term is about one-fifth of the fetal weight.

The fetus and the placenta undergo the same stress and strain in utero life. Any disease process affecting the mother will have impact on both the fetus and the placenta.

Thus, placental measurement such as placental thickness must reflect the nutritional status of the fetus and the fetal outcome. Placental thickness is the simplest measurement of placental size.

It varies from being highest at the center and least at the periphery. Many observers have documented that measurement of placental thickness is to be taken perpendicularly at the level of umbilical cord [1, 2].

Many pathological conditions could induce placentomegaly as a result of inflammation, edema or compensatory hypertrophy. Thick placenta is seen in Rh-ve pregnancy, gestational diabetes, intrauterine infections and hydrops fetalis, whereas thin placenta is seen in preeclampsia, intrauterine growth restriction and chorioamnionitis.

Few studies have documented the role of measurement of placental thickness in predicting neonatal outcome. A study in African population concluded that placental thickness at various gestational ages was related to birth weight [1, 2]. Another study in Iranian population in 2013 showed only a weak positive correlation between placental thickness in second and third trimesters and fetal weight in these gestations and birth weight [3].

The role of thin, thick and normal placenta in determining neonatal outcome still remains unclear. Majority of these studies were retrospective and single-point studies [4–6]. So, the need for a follow-up prospective study to establish placental growth as a measure of neonatal outcome was lacking. Our study is a step in this direction to define normograms of placental thickness at 32 and 36 weeks and to critically observe neonatal outcome in those who deviate from the normal.

Methods

This was a prospective observational longitudinal study conducted in the Department of Obstetrics and Gynecology in collaboration with the Departments of Radio diagnosis and Pediatrics, Vardhman Mahavir Medical College and Safdarjung[1] Hospital, within a period of 18 months. Hundred and thirty pregnant women, who were sure of dates and gave informed consent, were recruited from Antenatal Clinic at 32 weeks and were followed up at 36 weeks and after delivery.

The pregnant women who were sure of their last menstrual period, with singleton pregnancy between 18 and 40 years of age, with normal BMI were included in this study. The women with medical or obstetric high risk factors like diabetes, hypertension, chronic renal disease, multiple pregnancy, congenital abnormalities of fetus, eccentric insertion of the umbilical cord, low lying placenta or placenta previa were excluded from the study.

After completing the PC-PNDT Act formalities, obstetric ultrasound was performed on Philips HDI 4000 machine using a 3.5-MHz curvilinear transducer. The fetus was observed for viability and gross anatomical defects, and gestational age was estimated using various growth parameters: biparietal diameter, femur length, abdominal circumference, head circumference [7]. Placenta was localized in a longitudinal section. The placental thickness was measured at the level of umbilical cord insertion in longitudinal direction from the lateral chorionic plate to the cord insertion excluding the retro placental area [1, 2]. Posterior placenta was not excluded from the study and was not found to be difficult to measure (Figs. 1, 2, 3, 4).

We calculated percentile of placental thickness for our study population. The pregnant women with placental thickness and diameter between 10th and 95th percentile were taken as having normal placental thickness and were followed up as one group, and pregnant women with thickness below 10th percentile and above 95th percentile were defined to be having abnormally thin or thick placenta and were classified as a separate group and were followed up till delivery.

Post-delivery birth weight of the baby, placental weight, Apgar score, maturity of baby and sex of the baby were noted. Birth weight of the baby was recorded. Placental thickness at 32 and 36 weeks was correlated with birth weight and neonatal outcome. Placental thickness was correlated with birth weight and neonatal outcome using Pearson's correlation coefficient. Mean and standard deviation were used to summarize continuous maternal variables. Proportion and percentages were used for categorical variables. Pearson's correlation analysis and the p values were calculated by the two-tailed significance. Levene's test for equality of variances and t test for equality of means were used for continuous variables.

Results

Of the 130 recruited women at 32 weeks, five delivered prior to 36 weeks. Hundred and twenty-five women were followed up at 36 weeks and post-delivery. The mean age of our study population was 23.1 ± 3.02 years. Majority of the women were in age group of 19–23 years. The mean height of women in our study was 154.2 ± 4.56 cms, and the mean BMI was 21.85 ± 1.60 kg/m [2]. The majority of women in our study were nulliparous (68%) and belonged to lower middle class (72%) according to Kuppuswamy's socioeconomic scale.

The mean placental thickness at 32 and 36 weeks were 33.45 ± 1.62 and 35.7 ± 2.08 mm. In our study, placentae with thickness (determined by antenatal ultrasound) below 10th percentile ($<$mean $-$ 2SD) were considered as abnormally thin placentae. Also placentae with thickness more than 95th percentile ($>$mean $+$ 2SD) were considered as abnormally thick placentae.

Placental thickness between 10th and 95th percentile was considered normal at 32 and 36 weeks (Tables 1, 2).

The pregnant women were divided according to placental thickness—those with thin, normal and thick placenta.

Thin placenta: placental thickness less than 10th percentile.

Normal placental thickness: placental thickness between 10th and 95th percentile.
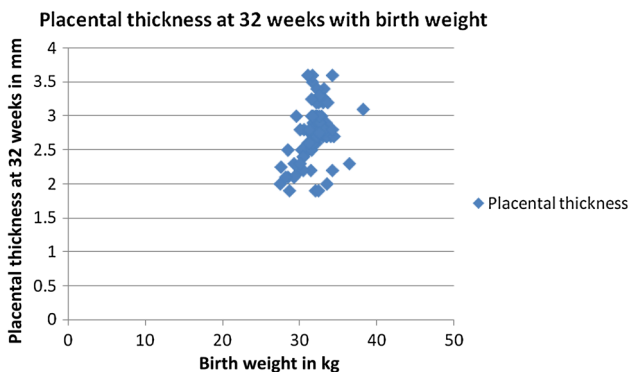
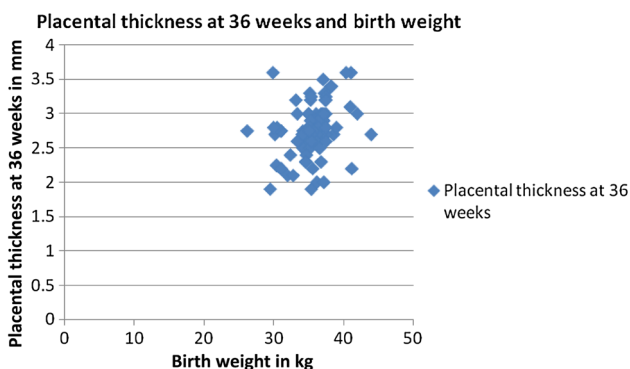Thick placenta: placental thickness more than 95th percentile.

Fig. 1 Placental thickness in a pregnant woman at 32 weeks. The placental thickness is 31.8 mm which correlated with gestational age and biometric parameters

Fig. 2 Placental thickness in a pregnant woman at 36 weeks. The placental thickness is 36.1 mm which correlated with gestational age and biometric parameters

Fig. 3 Correlation of placental thickness with birth weight at 32 weeks

Fig. 4 Correlation of placental thickness with birth weight at 36 weeks

Table 1 Mean, 10th and 95th percentile placental thicknesses at 32 and 36 weeks

	32 weeks ($n = 130$) (mm)	36 weeks ($n = 125$) (mm)
Mean placental thickness (mm)	33.45	35.7
10th percentile placental thickness (mm)	30.2	31.1
95th percentile placental thickness (mm)	35.7	39.9

Statistical analysis was performed for the study using Pearson's correlation coefficient and p values were calculated. There was a good correlation between placental thickness and biometric parameters ($r = 0.67$ at 32 weeks and $r = 0.735$ at 36 weeks). Also, there was a strong positive correlation between placental thickness and birth weight according to Pearson's correlation analysis ($r = 0.55$ at 32 weeks and $r = 0.740$ at 36 weeks).

The Pearson's correlation coefficient (r) between placental thickness and Apgar score at 32 weeks was 0.281 and at 36 weeks was 0.303 (p value = 0.003), which is statistically significant. However, no correlation was found between placental thickness and age of women ($r = -0.02$ at 32 weeks and $r = -0.06$ at 36 weeks), BMI of the patient ($r = 0.007$ at 32 weeks and $r = -0.006$ at 36 weeks), socioeconomic status (0.005 at 32 weeks and -0.001 at 36 weeks), parity (-0.03 at 32 weeks and -0.07 at 36 weeks) (Figs. 3, 4).

Discussion

Normal placental function and structure are required for normal growth and development of the fetus. Placental thickness is the simplest measurement of placental size and can be measured at any center equipped with ultrasound machine. The correlation of placental thickness with gestational age has been documented by many observers [1, 2, 6–8].

Schwartz et al. in 2010–2011 studied two-dimensional sonographic placental measurements in 1909 singleton pregnancies in Philadelphia between 18 and 24 weeks and found that mean placental thickness and diameter were significantly smaller in small-for-gestational-age infants [1]. Afrakhteh et al. found a positive correlation between placental thickness and gestational age in their prospective follow-up study in Iranian population [3]. Our study on the other hand was a prospective follow-up study which showed a strong positive correlation between placental thickness and birth weight at 32 and 36 weeks. Also,

Table 2 Correlation of thin, normal and thick placenta with birth weight, Apgar score and NICU admission at 32 and 36 weeks

Gestational age in wks	Placental thickness in mm	No. of women	Percentage of women (%)	Cesarean delivery	Birth weight < 2.5 kg	Mean birth weight	Apgar < 4 at 1 min	Apgar < 4 at 5 min	NICU admission	Mean duration of NICU stay (in days)
32 weeks	≤30.1	12	9.2	5	8	2.06	10	8	8	5.25
($n = 130$)	30.1–36.7	111	85.3	15	15	2.76	12	9	9	3.88
	≥36.8	7	5.3	4	5	2.24	6	5	5	6.4
36 weeks	≤31.0	15	12	5	12	2.13	11	10	9	5.88
($n = 125$)	31.1–39.9	103	82.4	15	11	2.71	12	9	6	4.16
	≥40.0	7	5.6	4	5	2.24	6	5	4	6.4

normograms were defined for placental thickness. The neonatal outcome in terms of birth weight, Apgar score and neonatal ICU admissions was better in women with normal placental thickness than those with abnormally thin or thin placentae. This can be used to identify the fetuses at risk by identifying women with thin placenta (below 10th percentile) and thick placenta (>95th centile).

Afrakhteh et al. in their study of 250 Iranian women found a significant positive correlation of placental thickness in both second and third trimesters with birth weight [3]. However, they concluded that placental thickness change could not predict low birth weight. Ahn KH in 2017 published that the higher placental thickness-to-estimated fetal weight ratio at 18–24 weeks gestation was associated with small-for-gestational-age infants [8]. In our study, we observed increased incidence of perinatal morbidity in terms of low Apgar scores and increased NICU admissions in those with placental thickness >4.0 cm at 36 weeks, and our study showed increased incidence of low-birth-weight babies in women with thick placenta.

Out of the 19 (15.2%) babies admitted to NICU out of 125 deliveries beyond 36 weeks, five babies had transient tachypnoea of newborn, eight had severe birth asphyxia, and six had meconium aspiration syndrome. Four babies (two with severe birth asphyxia and two with meconium aspiration syndrome) expired in NICU.

Thin placenta can be due to preeclampsia, intrauterine growth restriction and chorioamnionitis. Mathai et al. in 2013 studied the correlation of placental thickness in 498 subjects with ultrasonographic gestational age and fetal outcome by dividing them into two groups—Group A (outcome fetal weight <2500 g, $n = 122$) and Group B (fetal weight >2500 g, $n = 376$). They found a positive correlation between placental thickness and ultrasonographic gestational age in both groups. They also concluded that placental thickness in Group A between 26 and 27 weeks and 30 and 31 weeks had lower mean values of 2.48 ± 0.063 cm (p value < 0.05) and 2.76 ± 0.552 (p value = 0.05) as compared to 3.04 ± 0.25 and 3.13 ± 0.183 cm in Group B [9]. Elsafi Ahmed et al. studied ultrasonographic placental thickness in 53 Sudanese pregnant women in second and third trimesters. They concluded that thickness of less than 25 mm during third trimester is less than normal and might be an indication of intrauterine growth restriction and thickness of more than 45 mm was considered thicker than normal, which might be an indication of maternal *diabetes, hypertension, fetal hydrops and other abnormalities* [10]. *Normal values of placental* thickness in normal Sudanese singleton fetuses were in range of 25–45 mm in the 3rd trimester, and between 18 and 24 mm, in the second trimester. Li et al. in 2015 demonstrated sonographic placental thickness as one

of the cost-effective screening tool for detecting α-thalassemia major fetuses [11]. Normal placental thickness in Indian women was found to be 30.1-36.7 mm at 32 weeks and at 31.1–39.9 mm at 36 weeks in our study. Our study showed that placental thickness less than 3.0 cm at 32 weeks and 3.1 cm at 36 weeks is associated with low-birth-weight babies and poor fetal outcome.

The lacunae of our study include less number of patients and lack of intervention. Future studies could include interventions to see role of nutritional, life style factors and anticoagulants on placental thickness and fetal outcome.

Conclusion

There was a good correlation between placental thickness and birth weight according to Pearson's correlation analysis. ($r = 0.405$ at 32 weeks and $r = 0.740$ at 36 weeks).

The Pearson's correlation coefficient (r) between placental thickness and Apgar score at 32 weeks was 0.281 and at 36 weeks was 0.303 (p value = 0.003) which is statistically significant.

Neonatal outcome was good when placental thickness was between 31.1 and 39.9 mm (10th–95th percentile) at 36-week gestation, with good Apgar scores in 88.2% babies and poor Apgar scores in 11.8% babies. NICU admissions were there in 10% cases.

Fetal outcome was compromised when placental thickness was <10th percentile (<31.1 mm), with good Apgar scores in 25% babies and poor Apgar scores in 75% babies. NICU admissions were there in 75% cases.

Fetal outcome was compromised when placental thickness was > 95th percentile at 36 weeks (>39.9 mm), with good Agar scores in 20% babies and poor Apgar scores in 80% babies. All the babies were admitted to NICU.

Placental thickness on ultrasound can be used along with other biometric parameters in predicting neonatal outcome as placental thickness below 10th percentile was found to be associated with low-birth-weight infants and poor Apgar score and increased nursery admissions. Placental thickness above 95th percentile was also associated with poor neonatal outcome (poor neonatal Apgar scores and increased nursery admissions). So, measurement of placental parameters should be incorporated in all routine antenatal ultrasounds.

PC-PNDT Act PC-PNDT Act requirements were complied with for all the study subjects.

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