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Original Research Article

Determination of Accuracy of Ultrasonographic Placental Thickness in the Third Trimester of Pregnancy in Predicting Perinatal Outcome

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Abstract:

Background: The presence of variations in placental thickness is associated with an increased risk of perinatal morbidity and mortality. Nevertheless, only a limited number of studies have been conducted on the association between placental thickness and perinatal outcomes. The objective of the present research was to determine the association between placental thickness in the third trimester and neonatal outcomes, maternal weight gain, and body mass index (BMI).

Methods: A total of 224 patients aged between 20 to 40 years with singleton pregnancy and regular menstrual history, and sure about their last menstrual period were included in the study. Placental thickness was measured at 32 and 36 weeks by ultrasound and was divided into three groups: Group A (thin placenta), Group B (normal placenta), and Group C (thick placenta); and correlated with neonatal outcome, maternal weight gain, and BMI. Statistical analysis was done using the SPSS Statistics for Windows, V. 22.0. Pearson's correlation analysis was employed to ascertain the association between placental thickness and neonatal birth weight, maternal weight gain, and BMI.

Results: Out of 224 pregnant women, 128 (57.14%) were primigravida and 96 (42.86%) were multigravida. Eight out of twenty-one pregnant women with thin placenta at 32 weeks (08; 38.0%) and Five out of twenty-six pregnant women with thin placenta at 36 weeks (05; 19.2%)delivered very low birth weight (LBW) neonates (<2 kg) who were shifted to the NICU. There is increased incidence of antenatal, intrapartum, and postpartum complications were observed in pregnant women with thin placenta. The mean maternal weight gain during pregnancy was 10.6 ± 0.9 kg. A negative linear correlation was observed between maternal BMI and birth weight (at 32 weeks: r = - 0.061 and p = 0.516; at 36 weeks: r = - 0.069 and p = 0.586), and a positive linear correlation was observed between maternal weight gain and birth weight (at 32 weeks: r = 0.673 and p<0.0001; at 36 weeks: r = 0.693 and p<0.0001).

Conclusion: The present study suggests that a significant correlation is found between placental thickness and birth weight. Ultrasound measurement of placental thickness, in conjunction with other biometric parameters, can predict neonatal outcomes since a thickness below the 10th percentile correlates with low birth weight, poor Apgar scores, and increased NICU admissions to the hospital. Placental thickness above the 95th percentile was correlated with poor neonatal outcomes. Measurement of placental parameters should be included in all standard prenatal ultrasounds.

Keywords: Gestational diabetes, Gestational weight gain, Fetal growth, Placenta previa

Introduction

The placenta is an essential organ in the fetus, performing a variety of functions, including metabolic, immunological, endocrine, respiratory, and nutritional. It serves a crucial function in safeguarding the foetus by functioning as a barrier against infections and toxic substances. The proper growth and development of the foetus depends on the structure and function of the placenta. During

term pregnancy, the placenta's weight constitutes approximately one-fifth of the weight of the foetus. Alterations in maternal metabolism influence placental function and architecture, ultimately impacting birth weight at delivery. Maternal weight gain during pregnancy significantly influences foetal growth development and indirectly impacts adult health outcomes [1, 2]. The advent of ultrasonography and its recent developments enables Doppler imaging of the placenta, facilitating the examination of its morphology, uteroplacental circulation, and variability in complicated pregnancies. Placental thickness is shown to increase as pregnancy progresses. The placental thickness at the cord insertion location demonstrated a linear correlation with gestational age [3].

Furthermore, differences in placental thickness were associated with increased perinatal morbidity and mortality. Low birth weight (LBW) is a well-documented risk factor for long-term consequences, particularly metabolic and cardiovascular problems. Recently, researchers have found numerous factors of abnormal neonatal birth weight, encompassing both low and high values. A thick placenta is noted in Rh-negative pregnancies, intrauterine infections, gestational diabetes, and foetal hydrops, while a thin placenta is observed in preeclampsia, chorioamnionitis, and intrauterine growth restriction (IUGR).

Limited research has shown the significance of placental thickness in predicting foetal outcomes, and even fewer studies have confirmed a correlation between placental thickness at different gestational ages and birth weights [1, 2]. A study in Iran found a weak positive correlation between placental thickness and both foetal weight and birth weight [6]. The effect of normal, thin, and thick placentas on foetal outcomes remains unclear. Furthermore, the majority of the existing studies employed a retrospective design [7]. Consequently, there is a dearth of prospective and follow-up studies to determine the association between placental thickness and neonatal outcomes. This study was designed to determine the association between placental thickness in the third trimester and neonatal outcomes, maternal weight gain, and body mass index (BMI).

Material and Methods

This prospective, observational study was conducted for one year, from January 2022 to December 2022, in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital in Srikakulam, Andhra Pradesh, India, following the acquisition of ethical clearance. The sample size was determined using Cohen's d effect size, with an anticipated correlation coefficient (r) at a significance level of 95% and a power of 90%. The study required a minimum sample size of 220 individuals; however, we recruited 224 patients to ensure that we had a sufficient number of participants in the event that any of them decided to withdraw from the study.

After obtaining written informed consent, the study included a total of 224 prenatal women who were between the ages of 20 and 40, had a singleton pregnancy, had a regular menstrual history, were certain about their most recent menstrual cycle, and had no history of using oral contraceptives prior to becoming pregnant. The study excluded women with pregnancy risk factors such as hypertension, diabetes, chronic renal disease, and sickle cell anemia, as well as those with foetal congenital abnormalities, placental malformations, placental abruption, placenta previa, and multiple pregnancies.

In order to determine the placental thickness of each patient, ultrasonography was performed using a curvilinear transducer (3.5 MHz) of a Mindray DC 80 X insight. The measurements were taken at 32 weeks and 36 weeks during the third trimester, respectively, in each patient. The placenta was located in a longitudinal section. The placental thickness was assessed at the umbilical cord insertion point in a longitudinal orientation, extending from the lateral chorionic plate to the cord insertion while excluding the retroplacental region; the maximum thickness was recorded in the cross-sectional view (Figure 1).

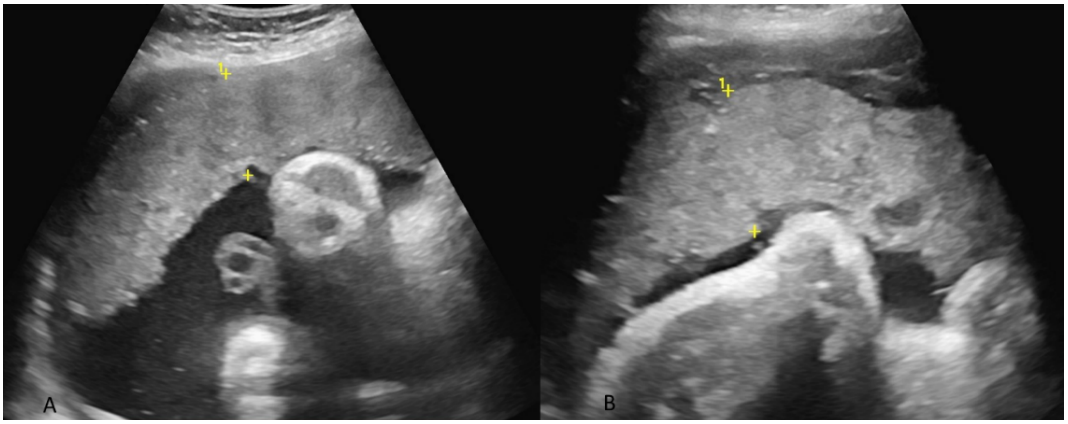

Figure 1: Ultrasonographic measurement of placental thickness in a antenatal woman at 32 weeks (A) and 36 weeks (B). The placental thickness was correlated with gestational age and biometric parameters

All patients were positioned supine with a distended urinary bladder during ultrasonography and monitored for any variations inplacental thickness until delivery [8]. For the purposes of our investigation, placental thickness was assessed in percentiles. Pregnant women were classified into three categories based on placental thickness: Group A (thin placenta; thickness <10th percentile or < mean - 2SD), Group B (normal placenta; thickness between 10th and 95th percentile), and Group C (thick placenta; thickness >95th percentile or > mean + 2SD) [8]. The pregnant women in Groups A and C were regularly monitored and followed up until delivery to detect any potential signs of IUGR, preterm labour, maternal pregnancy-induced hypertension (PIH), gestational diabetes mellitus (GDM), and abortion. Post-delivery neonatal birth weight, Apgar score, necessity for NICU admission, and mode of delivery were documented.

Statistical analysis was conducted utilising SPSS statistical software for Windows, Version 22.0. The Shapiro-Wilk test was employed to confirm the normality of the data. Continuous variables with a normal distribution were expressed as mean ± standard deviation, whereas categorical variables were represented as frequencies and percentages. Pearson's correlation analysis was employed to ascertain the association between placental thickness and neonatal birth weight, BMI, and maternal weight gain. A p-value of less than 0.05 was deemed statistically significant at a 95% confidence interval.

Results

Out of 224 pregnant women, 128 (57.14%) were primigravida and 96 (42.86%) were multigravida. The mean age and BMI of all pregnant women were 27.1±3.16 years and 21.5±1.54 kg/m2, respectively. Majority of them were in the age group of 22-30 years. Twenty-eight patients had low BMI (18-20 kg/m2). The mean placental thickness at 32 weeks and 36 weeks during 3rd trimester was 34.3 and 36.4 mm, respectively. Twelve patients delivered before 36 weeks and, therefore, could not undergo the third trimester ultrasound for placental thickness at 36 weeks. Consequently, only 212 pregnant women were considered for the measurement of placental thickness at 36 weeks. A mean placental thickness of <30.3 mm and <31.7 mm was considered as thin placenta at 32 and 36 weeks of gestation, respectively. Placental thickness >36.9 mm and >39.8 mm was considered as thick placenta at 32 and 36 weeks of gestation, respectively. Table 1 represents the distribution of pregnant women with thin (Group A), normal (Group B), and thick placenta (Group C) in 3rd trimester.

Table 1: Distribution of antenatal women with, thin (Group A), normal (Group B), and thick placenta (Group C) and 10th and 95th percentiles of placental thicknesses at 32 and 36 weeks of gestation (n = Total number of antenatal women)

Group	Placental thickness	At 32weeks (in mm)	At 36 weeks (in mm)	At 32weeks (n=224)	At 36weeks (n=212)
A	Thinplacenta; Placentalthickness(in mm) <10thpercentile	<30.3	<31.7	21	26
B	Normal placental thickness. Placental thickness (in mm) between 10th and 95th percentile	30.3–36.9	31.7–39.8	191	172
C	Thick placenta. Placental thickness (in mm) >95th percentile	>36.9	>39.8	12	14

Eight out of twenty-one pregnant women with thin placenta at 32 weeks (08; 38.0%) delivered very low birth weight (LBW) neonates (<2 kg) who were shifted to the NICU. Seven among these eight pregnant women had preterm delivery and the two neonates died in the NICU, probably due to preterm birth and/or acute respiratory distress syndrome (ARDS). Eight out of twenty-one pregnant women with thin placenta at 32 weeks (8; 38.0%) delivered low birth weight (LBW) neonates (2-2.5 kg). Nine out of twelve pregnant women with thick placenta at 32 weeks (09; 75.0%) delivered neonates with birth weight ≥3 kg; Three out of twelve pregnant women with thick placenta at 32 weeks delivered low birth weight (LBW) neonates; Five of these twelve pregnant women had gestational diabetes mellitus and high maternal weight gain. Table 2 represents the antenatal and perinatal complications among pregnant women with thin, normal, and thick placenta.

Table 2: Correlation of thin, normal and thick placenta with birth weight, Apgar score and NICU admission at 32 and 36 weeks (n = Total number of antenatal women)

Gestational age in weeks	32weeks (n= 224)			36weeks (n= 212)		
Category	Group A	Group B	Group C	Group A	Group B	Group C
Placental thickness in mm	<30.3	30.3–36.9	>36.9	<31.7	31.7–39.8	>39.8
Number of women	21	191	12	26	172	14
Percentage of women (%)	9.37	85.26	5.35	12.26	81.13	6.60
IUGR	17	27	4	19	25	5
Eclampsia	3	2	0	3	2	0
Oligohydramnios	19	31	3	21	29	5
Polyhydramnios	0	5	4	0	5	4
GDM	0	0	5	0	0	5
Vaginal delivery	10	163	5	14	145	6
Caesarean delivery	11	28	7	12	27	8
Birth weight<2.5kg	16	24	3	18	22	4
Meanbirth weight	2.12	2.82	2.41	2.18	2.89	2.44
Apgar score4 at1min	18	32	5	23	34	8
Apgar score4 at5min	16	25	4	19	24	6
NICU admission	16	24	4	17	21	4
MeanNICU stay (in days)	5.32	3.25	6.71	5.13	3.02	6.14

PIH=Pregnancy induced hypertension, IUGR=Intrauterine grow threstriction, GDM=Gestational diabetes mellitus, NICU=Neonatal intensive care unit

Five out of twenty-six pregnant women with thin placenta at 36 weeks (05; 19.2%) delivered very low birth weight (LBW) neonates (<2 kg) who were shifted to the NICU. One neonate died in the NICU, probably due to preterm birth and/or acute respiratory distress syndrome (ARDS). Thirteen out of twenty-six pregnant women with thin placenta at 36 weeks (13; 50%) delivered low birth weight (LBW) neonates (2-2.5 kg). Ten out of fourteen pregnant women with thick placenta at 36 weeks (10; 71.4%) delivered neonates with birth weight ≥3 kg; Four out of fourteen pregnant women with thick placenta at 36 weeks delivered low birth weight (LBW) neonates; Five of these fourteen pregnant women had gestationaldiabetesmellitus and high maternal weight gain (Table 2).

The mean birth weight in group A, B, and C at 32 weeks and 36 weeks was 2.12, 2.82, 2.41 kg and 2.18, 2.89, 2.44 kg respectively. Eight pregnant women with low BMI had thin placenta at 32 weeks and nine at 36 weeks. The mean maternal weight gain during pregnancy was 10.6 ± 0.9 kg. Eight pregnant women had maternal weight loss (5-6 kg) during pregnancy and delivered LBW neonates. A negative linear correlation was observed between maternal BMI and birth weight (at 32 weeks: r = - 0.061 and p = 0.516; at 36 weeks: r = - 0.069 and p = 0.586), and a positive linear correlation was observed between maternal weight gain and birth weight (at 32 weeks: r = 0.673 and p<0.0001; at 36 weeks: r = 0.693 and p<0.0001) (Table 2).

Discussion

A normal structure and function of the placenta are crucial for proper foetal growth and development. Adverse neonatal outcomes and foetal growth (placental efficiency) vary significantly according to geographic regions and ethnic backgrounds [1, 2, 9, 10]. In this investigation, placental thickness was utilised to evaluate neonatal outcomes. The current study reported a relatively low incidence of thin placenta at 32 weeks and 36 weeks, with rates of 9.37% and 12.26%, respectively. Audette et al. conducted a study involving 829 nulliparous pregnant women, revealing a high incidence of thin placentas (24.2%) among South Asian pregnant women [11]. The conflicting results may be attributed to a limited sample size in the present

investigation. A thin placenta may result from IUGR, preeclampsia, and chorioamnionitis [9].

A study by Afrakhteh et al. demonstrated a positive linear correlation between placental thickness and fetal age [6]. In 2013, Mathai et al. assessed the relationship between placental thickness, gestational age, and foetal outcomes in 498 individuals, categorising them into two groups: Group A (foetal weight <2500 g) and Group B (foetal weight >2500 g). A moderately positive correlation was identified between ultrasonographic gestational age and placental thickness in both groups. The researchers also determined that the mean placental thickness in Group A is comparatively lower than in Group B [12].

A study conducted by Schwartz et al. in Philadelphia found that preterm newborns had considerably reduced mean placental thickness [2]. The women in the study were between the ages of 18 and 24 and had singleton pregnancies (n = 1909). The present study determined a moderate positive linear correlation between placental thickness and birth weight at 32 weeks ($r = 0.673$, $p < 0.0001$) and 36 weeks ($r = 0.753$, $p < 0.0001$). In contrast, Kashika et al. reported a strong positive correlation at 32 weeks ($r = 0.55$) and 36 weeks ($r = 0.74$) of gestational age. In a prospective study of 250 singleton pregnancies, Afrakhteh et al. found a positive association between placental thickness and birth weight in the second and third trimesters, which is consistent with the findings of our investigation. Nevertheless, they determined that changes in placental thickness could not anticipate low birth weight [6].

In the current study, it was observed that pregnant women with thin placentas had a higher incidence of antenatal, intrapartum, and postpartum complications. These complications included preterm delivery, oligohydramnios, low birth weight neonates, admission to the NICU, poor Apgar score (<4 at 1 minute), and the need for emergency LSCS. On the other hand, pregnant women with thick placentas had a higher incidence of polyhydramnios. Kashika et al. observed an increased incidence of low Apgar scores, NICU admissions, and low birth weight neonates associated with thick placentas [8].

It was found that the antenatal women who had thick placentas had a higher incidence of perinatal mortality as well as foetal anomalies [8]. In a study conducted by Ahmed et al., a group of Sudanese women (n = 53) who were pregnant during the second and third trimesters observed a higher incidence of IUGR with a thin placenta (<25 mm) at 36 weeks of gestational age. The researchers came to the conclusion that thin placenta could be a predictor of IUGR, while thick placenta (>45 mm) could be a predictor of GDM, PIH, and hydrops fetalis [13]. Consequently, in the current study, the incidence of polyhydramnios, glucose intolerance, and GDM was observed in cases where the placenta was thick ($\geq$ 36.9 and $\geq$ 39.8 millimetres at 32 and 36 weeks of gestational age, respectively). Reduced placental thickness may serve as an early indicator of IUGR, which can be managed if detected promptly. If the placental thickness exceeds 40 mm at term, it indicates placenta enlargement (placentomegaly), which typically correlates with GDM, intrauterine infections, hydrops fetalis, anaemia, and -thalassaemia type [13]. An increased placental thickness at that gestational age should prompt consideration of potential pathological disorders [14].

The association between placental measures and maternal characteristics was investigated in a study that was carried out in the United States of America on a total of 24,000 placentas. The findings of the study revealed that the placental weight accounts for 36.5% of the variation in the foetal weight, while maternal characteristics (including age, body mass index, parity, ethnicity, cigarette use, and socio-economic status) accounted for 13.9% of the variation in the foetal weight [15].

The current research discovered a moderate positive correlation between maternal weight gain and birth weight at 32 weeks ($r = 0.673$, $p < 0.0001$) and at 36 weeks ($r = 0.693$, $p < 0.0001$). Conversely, a negative correlation was found between maternal BMI and birth weight at 32 weeks ($r = -0.061$, $p = 0.516$) and at 36 weeks ($r = -0.069$, $p = 0.586$). Maternal weight gain and pre-pregnancy BMI were recognised as indicators of placental hypertrophy throughout all three dimensions of its growth. The literature that is currently accessible suggests that the impact of maternal weight gain and body mass index (BMI) on fetal and birth weight at least partially affects the growth of the placenta and the characteristics that it possesses [16].

There were not many limitations placed on our research. A limited cohort of patients may account for the reduced incidence of abnormal placental thickness. After that, while we were evaluating the newborn outcomes in connection to placental measurements, we did not take into account the nutritional and socio-economic status of the women who were enrolled in the study. It is necessary to conduct additional research in order to determine the extent to which birth occurrences are influenced by lifestyle behaviours, nutritional status, and socioeconomic level.

Conclusion

The current research concludes that a significant correlation is found between placental thickness and birth weight. The fetal and neonatal outcomes

were favourable when the placental thickness was between the 10th and 95th percentile at 32 and 36 weeks of gestation, with good Apgar scores and a very few NICU admissions. Fetal and neonatal outcomes were adversely affected when placental thickness was below the 10th percentile or above the 95th percentile.

Ultrasound measurement of placental thickness, in conjunction with other biometric parameters, can predict neonatal outcomes since a thickness below the 10th percentile correlates with low birth weight, poor Apgar scores, and increased NICU admissions. In addition, a placental thickness that was greater than the 95th percentile was associated with a poor neonatal outcome, which included low Apgar scores and increased NICU admissions. It is therefore recommended that all standard prenatal ultrasounds include the measurement of placental parameters.

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