

Non-Invasive Monitoring of Placental Growth: Ultrasonographic Assessment from Mid to Late Pregnancy

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Abstract: Background: As pregnancy progresses, the accuracy of current methods for estimating gestational age decreases. However, placental thickness tends to increase linearly with gestational age and might be a reliable indicator, especially in later stages of pregnancy.

Aim: This study aimed to explore the relationship between placental thickness and gestational age, along with commonly used fetal growth parameters during the second and third trimesters. Additionally, it investigated whether placental thickness is reduced in fetuses that are small for gestational age (SGA).

Methods: Conducted at a tertiary care center, this prospective observational study included 200 pregnant women who met specific inclusion and exclusion criteria. Routine antenatal ultrasounds were used to measure placental thickness at the umbilical cord insertion, as well as biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC). Gestational age was determined based on the last menstrual period.

Results: There was a significant correlation between placental thickness and gestational age ($p < 0.001$), BPD ($p < 0.001$), HC ($p < 0.001$), FL ($p < 0.001$), and AC ($p < 0.001$) across both trimesters. In the second trimester, placental thickness was strongly correlated with gestational age ($p < 0.001$), BPD ($p < 0.01$), HC ($p < 0.001$), and AC ($p < 0.001$). In the third trimester, it was strongly correlated with gestational age ($p < 0.001$), BPD ($p < 0.001$), HC ($p < 0.001$), FL ($p < 0.001$), and AC ($p < 0.001$). SGA babies had significantly thinner placentas compared to normal-weight babies ($p < 0.001$).

Conclusions: Placental thickness shows a strong correlation with gestational age, BPD, HC, and AC during the second and third trimesters. It is also significantly lower in SGA babies. Regular measurement of placental thickness via ultrasound can aid in predicting gestational age and identifying SGA babies.

Keywords: Gestational age, Placenta, Ultrasound imaging, Intrauterine growth restriction, Low birth weight.

Background

The most accurate method for estimating or confirming gestational age (GA) is first-trimester ultrasound (USG) of the embryo or fetus. Accurate GA estimation is essential for routine antenatal care, successful prenatal delivery, and optimal postnatal care, especially in developing countries. This accuracy is crucial for timely maternal and neonatal management after birth. In the second and third trimesters, biometric parameters such as biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) are commonly used for dating scans. However, these parameters can sometimes provide inconsistent GA estimates, such as in breech-presenting fetuses, and their accuracy decreases as pregnancy progresses. This highlights the need for additional parameters to complement these established measurements, particularly in the late third trimester.

The placenta plays a crucial role in fetal growth, acting as a multifunctional organ that facilitates the transfer of materials and nutrients between the mother and fetus. Changes in placental thickness (PT), which can be measured by ultrasonography, reflect normal growth of the fetoplacental unit. Previous studies suggest a linear increase in PT with GA during a normal pregnancy.

Immature placentas indicate insufficient uteroplacental blood flow, and small for gestational age (SGA) is a major cause of perinatal mortality due to neonatal asphyxia, developmental disorders, and other complications. The relationship between PT and SGA remains inconclusive.

Our study aimed to investigate the correlation between placental thickness (PT) and gestational age (GA), as well as with BPD, HC, FL, and AC, in second and third trimester pregnancies using ultrasonography. Additionally, we aimed to assess the association between PT and expected fetal weight to predict SGA infants in our population.

Methods

Study Design: This prospective observational study was conducted at Maharajah's institute of medical sciences, Nellimarla from January 2022 to February 2023, following approval from the institutional ethical committee. Written informed consent was obtained from all participants. The study included 200 pregnant women in their second and third trimesters who attended routine antenatal checkups or were referred from the Obstetrics Department.

Inclusion Criteria: Pregnant women with gestational ages between 15 and 39 weeks with normal singleton pregnancies.

Exclusion Criteria: Excluded were women with maternal comorbidities such as diabetes mellitus, hypertension, severe anemia, heart disorders, jaundice, kidney disorders, history of previous intrauterine growth restriction (IUGR), and adverse fetal outcomes. Also excluded were cases with placental abnormalities (e.g., placenta previa, placental pathology), uterine or adnexal masses, fetal disorders (e.g., IUGR, fetal anomalies, hydrops fetalis), multiple pregnancies, polyhydramnios, and oligohydramnios.

Ultrasound Evaluation: Routine obstetric ultrasounds were performed using the Philips affinity 70 HD machine (Convex transducer 3–5 MHz). Placental thickness was measured in millimeters at the level of umbilical cord insertion, localized in a longitudinal section. The measurement was taken from the edge of the echogenic chorionic plate to the interface with the myometrium, ensuring the exclusion of the myometrium and sub-placental veins and during the relaxation phase of the uterus. Routine measurements of BPD, HC, FL, and AC were also taken. A composite average of gestational age was calculated. All fetuses were monitored until birth, with fetal birth weight and SGA status recorded.

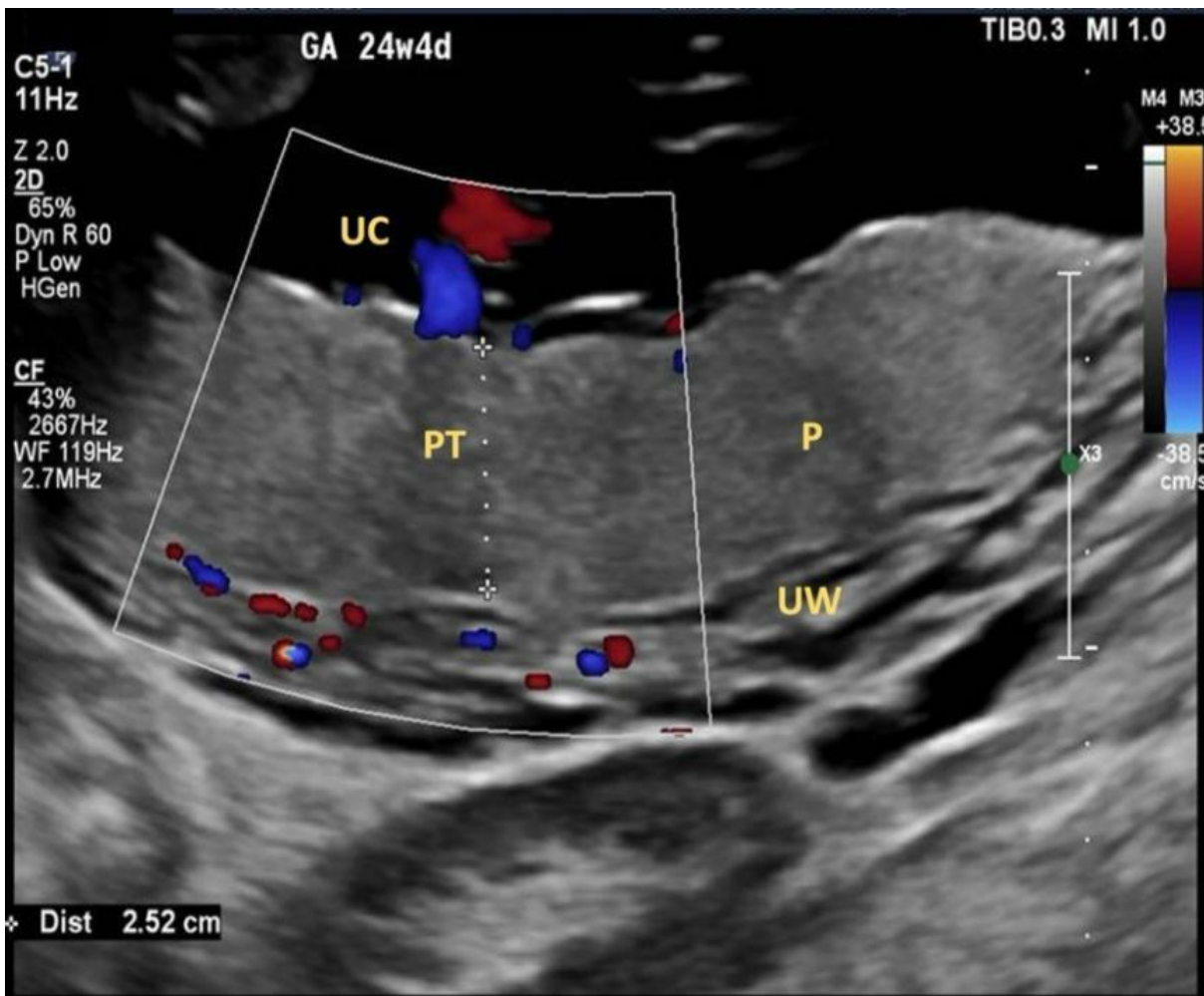


Fig. 1

Technique of measurement of placental thickness, where PT— Placental thickness, UC—Umbilical cord, UW— Uterine wall, P— Placenta.

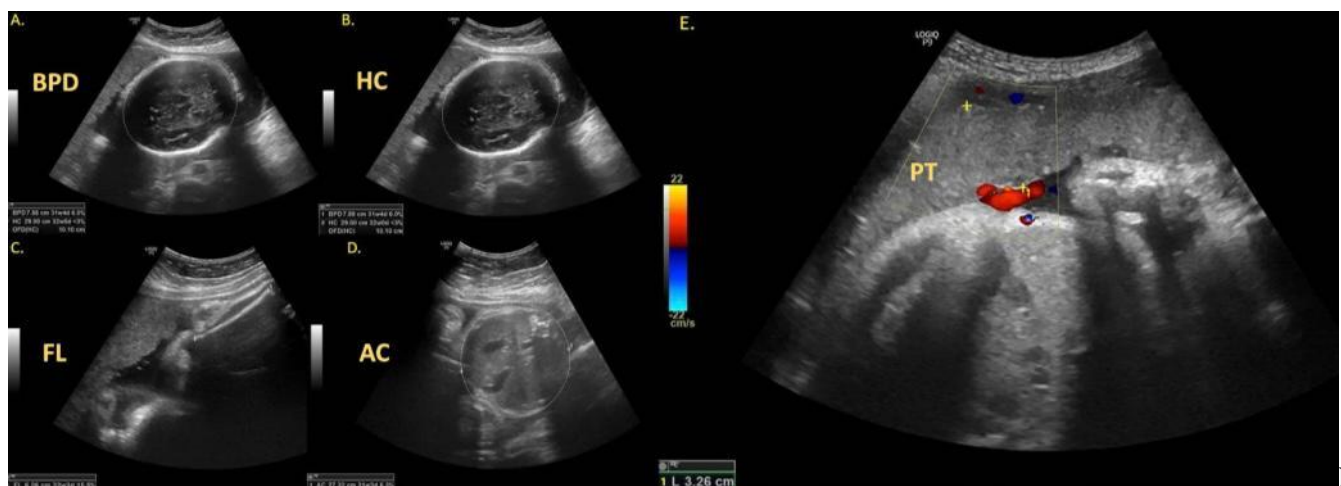


Fig.

2 Fetal biometry measurement on USG with gestational age corresponding to 33 weeks 3 days: A HC, B BPD, C FL, D AC (E) PT.

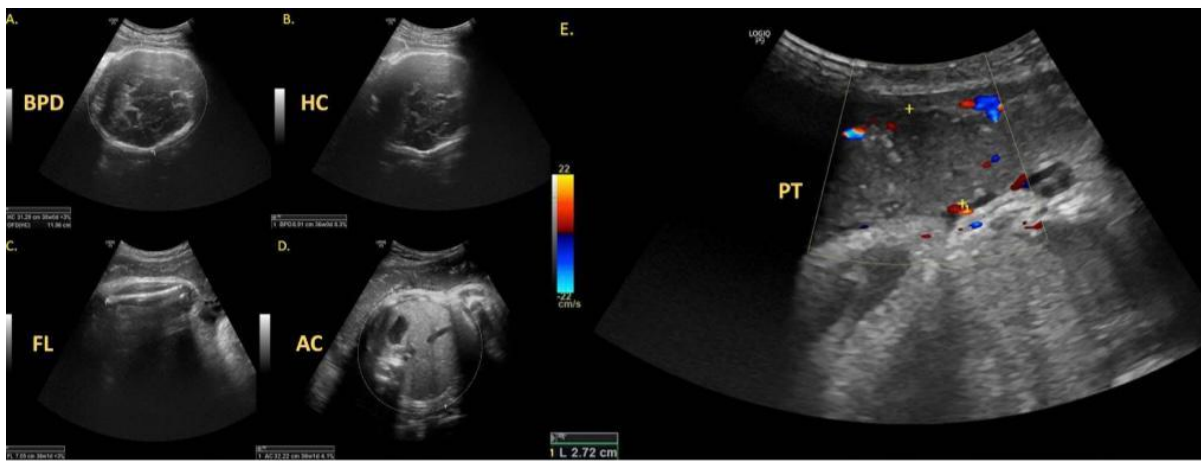


Fig. 3 Thin placenta—Fetal biometry measurement on USG. Gestational age corresponding to 35 weeks 5 days: A HC, B BPD, C FL, D AC E PT. The maximum placental thickness was 2.72 cm which was below the normal mean reference value (3.44 ± 0.25) and baby was SGA when delivered.

Statistical Analysis

Descriptive statistics were used, with mean and standard deviation for quantitative variables and frequency and proportion for categorical variables. An independent sample t-test assessed statistical significance. Cross-tabulation and percentage comparisons evaluated the association between explanatory variables and categorical outcomes. Pearson correlation coefficient was used to assess the relationship between placental thickness and gestational age, FL, BPD, HC, AC, actual birth weight, and expected fetal weight, with results displayed in scatter plots. The association between weight-for-age percentile, placental position, and placental grade was also evaluated using cross-tabulation and percentage comparison. The Chi-square test determined statistical significance. A p-value of <0.001 was considered statistically significant.

Results

This study included 200 pregnant women who came to the Department of Radiology at Maharajah's institute of medical sciences Hospital for routine antenatal ultrasonography. Among them, 137 were in their third trimester (27-40 weeks of gestation), and 63 were in their second trimester (15-26 weeks of gestation). The age range of the participants was 17-36 years, with the majority (50%) being between 21 and 25 years old.

Placental Thickness in the Second Trimester:

The highest mean placental thickness was 3.07 ± 0.18 cm at 26 weeks.

The lowest mean placental thickness was 2.01 ± 0.23 cm at 18 weeks (Table 1).

Placental Thickness in the Third Trimester:

The highest mean placental thickness was 3.45 ± 0.27 cm at 31 weeks.

The lowest mean placental thickness was 2.87 ± 0.29 cm at 27 weeks (Table 2).

Correlation Analysis:

In the second trimester, placental thickness showed a strong correlation with gestational age ($r = 0.559$, $p < 0.001$), BPD ($r = 0.550$, $p < 0.001$), HC ($r = 0.533$, $p < 0.001$), and AC ($r = 0.839$, $p < 0.001$). There was no significant correlation with femur length ($r = 0.125$, $p = 0.333$) (Table 3).

In the third trimester, placental thickness was also significantly correlated with gestational age ($r = 0.383$, $p < 0.001$), femur length ($r = 0.434$, $p < 0.001$), BPD ($r = 0.438$, $p < 0.001$), and HC ($r = 0.307$, $p < 0.01$) (Table 3).

SGA vs. Normal Group:

Placental thickness was significantly lower in the SGA group (mean 2.64 ± 0.51 cm) compared to the normal group (mean 3.02 ± 0.57 cm) with a p-value of <0.001 (Table 4).

Table 1: Mean Placental Thickness (cm) in the Second Trimester (15-26 Weeks, 63 Subjects)

Gestational Age (weeks)	Number of Subjects (N)	Mean \pm SD (cm)
15	4 (6.3%)	2.06 \pm 0.37
16	1 (1.6%)	2.34
18	7 (11.1%)	2.01 \pm 0.23
19	10 (15.9%)	2.14 \pm 0.40
20	12 (19%)	2.08 \pm 0.12
21	9 (14.3%)	2.52 \pm 0.47
22	5 (7.9%)	2.28 \pm 0.43
23	4 (6.3%)	2.71 \pm 0.53
24	4 (6.3%)	2.57 \pm 0.34
25	4 (6.3%)	2.54 \pm 0.39
26	3 (4.8%)	3.07 \pm 0.18
Total	63 (100%)	2.31 \pm 0.43

Table 2: Mean Placental Thickness (cm) in the Third Trimester (27-39 Weeks, 137 Subjects)

Gestational Age (weeks)	Number of Subjects (N)	Mean \pm SD (cm)
27	3 (2.19%)	2.87 \pm 0.29
28	17 (12.40%)	2.99 \pm 0.31
29	12 (8.76%)	2.96 \pm 0.56
30	13 (9.48%)	3.22 \pm 0.34
31	10 (7.30%)	3.45 \pm 0.27
32	9 (6.56%)	3.20 \pm 0.19
33	13 (9.49%)	3.19 \pm 0.25
34	12 (8.76%)	3.45 \pm 0.26
35	18 (13.14%)	3.44 \pm 0.25
36	15 (10.95%)	3.35 \pm 0.32
37	7 (5.11%)	3.32 \pm 0.12
38	6 (4.38%)	3.30 \pm 0.36
39	2 (1.46%)	3.40 \pm 0.96
Total	137 (100%)	3.25 \pm 0.36

Table 3: Correlation Between Placental Thickness and Fetal Biometry in the Second and Third Trimesters

Parameter	Number of Patients	Pearson Correlation	p-value
Second Trimester			
Gestational Age	62	0.559	<0.001
FL	62	0.125	0.333
BPD	62	0.550	<0.001
HC	62	0.533	<0.001

Parameter	Number of Patients	Pearson Correlation	p-value
AC	62	0.839	<0.001
Third Trimester			
Gestational Age	135	0.383	<0.001
FL	135	0.434	<0.001
BPD	135	0.438	<0.001
HC	135	0.307	<0.001
AC	135	0.775	<0.001

Table 4: Comparison of Expected Fetal Weight and Placental Thickness Between SGA and Normal Babies

Parameter	SGA (Mean ± SD)	Normal (Mean ± SD)	p-value
Expected Fetal Weight (kg)	1.32 ± 0.95	1.60 ± 0.99	0.119
Placental Thickness (cm)	2.64 ± 0.51	3.02 ± 0.57	<0.001

Discussion

Placental thickness serves as an indicator of normal fetoplacental growth, progressively increasing with gestational age. Therefore, measuring placental thickness can aid in estimating gestational age and detecting fetal abnormalities. In our study, we aimed to correlate placental thickness (PT) with various fetal biometric parameters using ultrasonography in both the second and third trimesters. Additionally, we investigated its association with expected fetal weight to predict small for gestational age (SGA) infants.

Our findings revealed a positive correlation between placental thickness and gestational age, as well as with biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC) in both trimesters. This aligns with previous research indicating a linear relationship between PT and GA. Notably, our study suggests that PT measurements could complement traditional fetal growth parameters, especially in cases where BPD and HC measurements are challenging, such as with large fetuses or in late gestational periods.

Regarding placental thickness trends, we observed an increase in thickness up to around 35 weeks, followed by a slight decrease towards 39 weeks. This contrasts with some prior studies reporting a continuous increase or stabilization in placental thickness until late gestation. However, our findings are consistent with other research showing higher placental thickness compared to gestational age, particularly up to 21 weeks.

Our study also confirmed the significance of placental thickness in predicting SGA infants, consistent with previous literature associating lower placental thickness with low birth weight. This highlights the potential clinical utility of placental thickness measurements, extending even into late third trimester for predicting SGA infants.

Despite these valuable insights, our study had limitations, including the lack of serial placental thickness measurements and reliance on a single observer for data collection. Future research with larger sample sizes and serial measurements could provide more robust reference values for clinical practice.

Conclusions

Placental thickness exhibits a robust correlation with gestational age, alongside BPD, HC, and AC, across both the second and third trimesters. Moreover, it emerges as significantly reduced in small for gestational age (SGA) infants. Therefore, integrating routine placental thickness measurements into prenatal care can enhance the accuracy of gestational age prediction and facilitate the identification of SGA infants.

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