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RESEARCH

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Correlation of placental thickness with gestational age in second and third trimester using ultrasonography

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Abstract

Background The accuracy of currently established parameters in estimating gestational age decreases as pregnancy advances. With advancing gestational age, there is an expected linear increase in placental thickness. Placental thickness may thus be used to reliably predict gestational age, especially in later stages.

Aim Our study aimed to determine the relationship between placental thickness and gestational age and routinely used fetal growth parameters in the second and third trimesters. Additionally, we aimed to see if the placental thickness was lower in small for gestational fetuses.

Methods This study was performed at a tertiary care center and was a prospective observational study. We recruited consecutive 200 pregnant women fulfilling inclusion and exclusion criteria. Using routine antenatal ultrasonography, we obtained several measurements of placental thickness, BPD, HC, FL, and AC. The placental thickness was measured at the level of umbilical cord insertion. The gestational age was calculated using last menstrual period.

Results There was a strong correlation between placental thickness and gestational age ($p < 0.001$), BPD ($p < 0.001$), HC ($p < 0.001$), FL ($p < 0.001$), and AC ($p < 0.001$) in both trimesters combined. In the second trimester, there was a strong correlation between placental thickness and gestational age ($p < 0.001$), BPD ($p < 0.01$), HC ($p < 0.001$), and AC ($p < 0.001$). In the third trimester, there was a strong correlation between placental thickness and gestational age ($p < 0.001$), BPD ($p < 0.001$), HC ($p < 0.001$), FL ($p < 0.001$) and AC ($p < 0.001$). Patients delivering Small for gestational age (SGA) babies had significantly thinner placentas as compared to those with normal-weight babies ($p < 0.001$).

Conclusions Placental thickness has a strong correlation with gestation age as well as BPD, HC, and AC in the second and third trimesters. Placental thickness is significantly lower in small for gestational age babies. Routine measurement of antenatal placental thickness using ultrasound can help predict gestational age and detect small for gestational age babies.

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

Background

Currently, first-trimester USG in the embryo or fetus is the most accurate method for estimation or confirmation of gestational age (GA) [1]. Accurate estimation of GA is the basis of current routine antenatal USG scanning and is crucial for successful prenatal delivery and optimal postnatal care, especially in developing countries [2]. It is imperative for prompt postnatal maternal

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and neonatal management. Biometric parameters namely biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) are now routinely used in the second and third trimester dating scans [3]. However, these parameters can sometimes generate conflicting values of gestational age, for instance in fetuses in breech presentation [4]. Moreover, each of these comes with its set of drawbacks [5]. One of the many pitfalls reported is the decreased accuracy of these parameters as the gestational age advances [6]. This warrants the need to explore additional parameters that could complement the established biometric parameters, particularly in the late third trimester [7].

Placenta plays a critical role in normal fetal growth. It is a multifunctional organ, that performs the critical function of mediating the passage of materials and nutrients between the maternal and fetal circulation. Placental thickness (PT) changes are indicative of normal growth of the "fetoplacental unit" and can be measured by ultrasonography [8, 9]. Previous literature suggests that there is a linear increase in placental thickness with GA through the course of normal pregnancy [10].

Immature placentas reflect insufficient uteroplacental blood flow. SGA is listed as one of the major causes of perinatal mortality due to neonatal asphyxia, developmental disorders, and other complications [11]. There have been conflicting results regarding the association of placental thickness with SGA with no consensus.

Our study aimed to correlate placental thickness (PT) with gestational age (GA), biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC) using ultrasonography, in the second and third-trimester pregnancies. Additionally, we aimed to correlate placental thickness with expected fetal weight in predicting small for gestational age infants in our population.

Methods

Study design

This was a Prospective observational study, done in a tertiary care center in XXX, from the period of January 2019 to July 2020. The study was conducted after getting clearance from the institutional ethical committee. A written informed consent was obtained from all patients to be a part of the study. 200 pregnant women in the second and third trimesters of gestation, presenting to the Obstetrics OPD for routine antenatal checkups, and in-patients referred from the Department of Obstetrics were included in the study.

The inclusion criteria were all pregnant women with gestational age between 15 and 39 weeks with normal singleton pregnancies. The exclusion criteria were maternal co-morbidities like diabetes mellitus, hypertension, severe anemia, heart disorders, jaundice complicating pregnancy and kidney disorders, history of previous IUGR, and adverse fetal outcome.

Patients with placental abnormalities like- placenta previa, coexistent placental pathology, uterine or adnexal mass. Fetal Disorders like intrauterine growth restriction, fetal anomalies, or hydrops fetalis, multiple fetuses, polyhydramnios, and oligohydramnios were excluded from the study.

All the patients were evaluated by ultrasound for routine obstetric scans using GE LOGIQ P9.

MACHINE (Convex transducer 3–5 MHz). The placental thickness was measured in 'mm' at the level of umbilical cord insertion. Placenta was localized in a longitudinal section. Placental thickness measurement was taken from the edge of the echogenic-appearing chorionic plate to the interface of the placenta with the myometrium (Fig. 1). This was done at the level of cord insertion. Precautions were taken for proper identification of the cord insertion site; exclusion of the myometrium and sub-placental veins and measurements were taken during the relaxation phase. Routine BPD, HC, FL, and AC estimation was done (Fig. 2). A composite average of gestational age was derived. All fetuses were followed up till birth. Fetal birth weight and small for gestational age were recorded (Fig. 3).

Statistical analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Independent sample t-test was used to assess statistical significance. The association between explanatory variables and categorical outcomes

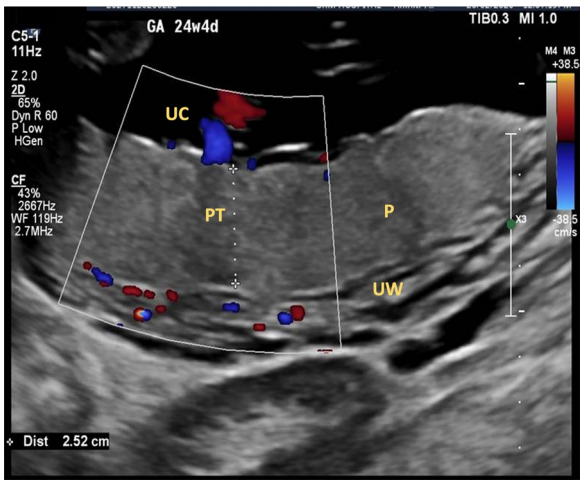

Fig. 1 Technique of measurement of placental thickness, where PT—Placental thickness, UC—Umbilical cord, UW-—Uterine wall, P—Placenta

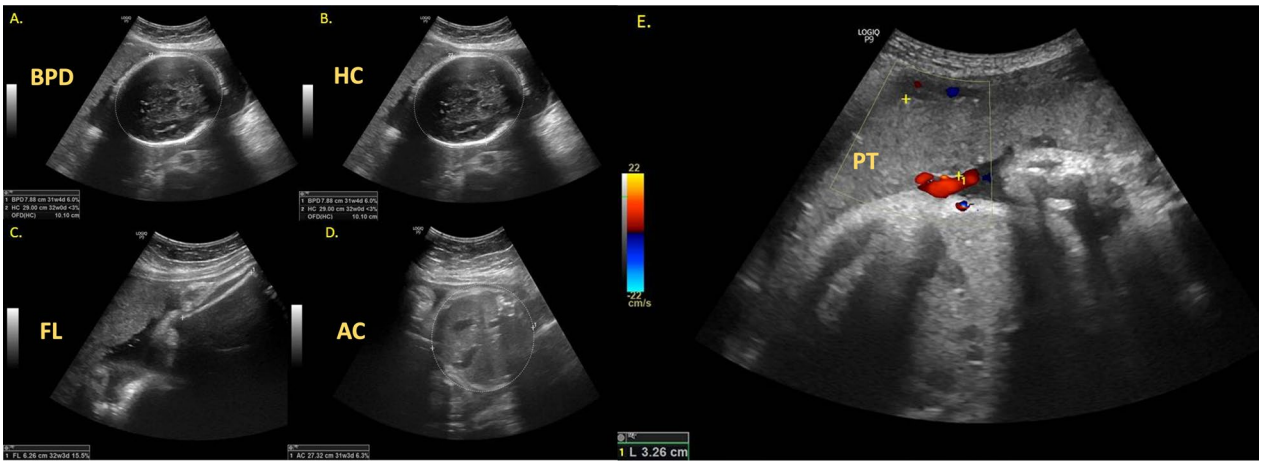

Fig. 2 Fetal biometry measurement on USG with gestational age corresponding to 33 weeks 3 days: **A** HC, **B** BPD, **C** FL, **D** AC (E) PT

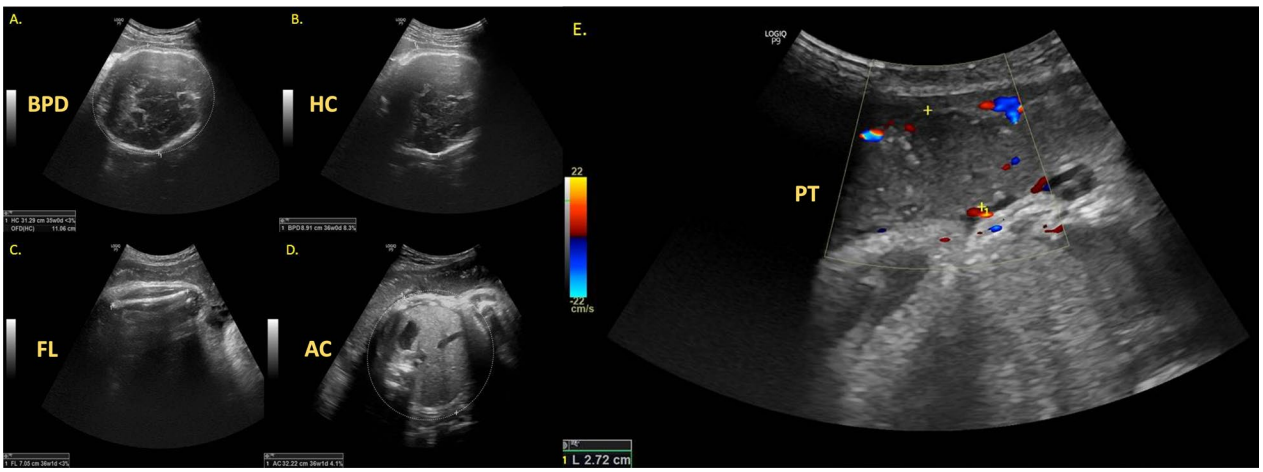

Fig. 3 Thin placenta—Fetal biometry measurement on USG. Gestational age corresponding to 35 weeks 5 days: **A** HC, **B** BPD, **C** FL, **D** AC **E** PT. The maximum placental thickness was 2.72 cm which was below the normal mean reference value (3.44 ± 0.25) and baby was SGA when delivered.

was assessed by cross-tabulation and comparison of percentages. The association between placental thickness and gestational age, FL, BPD, HC, AC, FL, actual birth weight, and expected fetal weight was assessed by calculating the Pearson correlation coefficient and the data was represented in a scatter diagram. The association between weight for age percentile and placental position and placental grade was assessed by cross-tabulation and comparison of percentages. Chi-square test was used to test statistical significance.

p value of < 0.001 was considered statistically significant.

Results

A total of 200 pregnant women who presented to the Department of Radiology, XXX Hospital for routine antenatal obstetric ultrasonography were enrolled in this study. Out of the 200 patients, 137 patients presented to us in the third trimester, between 27 and 40 weeks of gestation. The remaining 63 presented in the second trimester, between 15 and 26 weeks of gestation. The patient age group was in the range of 17–36 years. The maximum number of patients were within the age group of 21–25 years accounting for 50% of the study population.

The mean placental thickness for each gestational age in the 2nd trimester was derived. Maximum mean placental thickness in the second trimester was found to be 3.07 ± 0.18 at 26 weeks of gestation. Minimum mean placental thickness in the second trimester was 2.01 ± 0.23 at 18 weeks of gestation (Table 1).

The mean placental thickness for each gestational age in the third trimester was derived. Maximum mean placental thickness was found to be 3.45 ± 0.27 cm at

Table 1 Mean values of placental thickness (cm) in 2nd trimester 15–26 weeks (63 subjects)

2nd trimester	*N*	Mean ± SD
15	4 (6.3%)	2.06 ± 0.37
16	1 (1.6%)	2.34
18	7 (11.1%)	2.01 ± 0.23
19	10 (15.9%)	2.14 ± 0.40
20	12 (19%)	2.08 ± 0.12
21	9 (14.3%)	2.52 ± 0.47
22	5 (7.9%)	2.28 ± 0.43
23	4 (6.3%)	2.71 ± 0.53
24	4 (6.3%)	2.57 ± 0.34
25	4 (6.3%)	2.54 ± 0.39
26	3 (4.8%)	3.07 ± 0.18
Total	63 (100%)	2.31 ± 0.43

Table 2 Mean values of placental thickness(cm) in 3rd trimester 27–39 weeks (137 subjects)

3rd trimester	*N*	Mean ± SD
27	3 (2.19%)	2.87 ± 0.29
28	17 (12.40%)	2.99 ± 0.31
29	12 (8.76%)	2.96 ± 0.56
30	13 (9.48%)	3.22 ± 0.34
31	10 (7.30%)	3.45 ± 0.27
32	9 (6.56%)	3.20 ± 0.19
33	13 (9.49%)	3.19 ± 0.25
34	12 (8.76%)	3.45 ± 0.26
35	18 (13.14%)	3.44 ± 0.25
36	15 (10.95%)	3.35 ± 0.32
37	7 (5.11%)	3.32 ± 0.12
38	6 (4.38%)	3.30 ± 0.36
39	2 (1.46%)	3.40 ± 0.96
Total	137 (00%)	3.25 ± 0.36

31 weeks of gestation. Minimum mean placental thickness was found to be 2.87 ± 0.29 at 27 weeks of gestation (Table 2).

To find the correlation between placental thickness and other parameters like GA, FL, BPD, HC, and AC, the correlation coefficient was calculated (Table 3). There was a strong correlation between placental thickness and gestational age in the second trimester, with a Pearson coefficient (r) value of 0.559 and a p value of < 0.001. No statistically significant correlation is found between placental thickness and the femur length in second trimester, with r value of 0.125 and p value of 0.333. Placental thickness with BPD and HC both shows statistically significant correlation with r value of 0.550, 0.533 and p value of < 0.001, respectively.

Table 3 Correlation between placental thickness and 2nd/3rd trimester fetal biometry

	No 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
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 (in kg) and placental thickness between small for gestational age and normal babies

Parameter	Weight for age (Percentile)		*p* value
	SGA	Normal	
Expected fetal weight	1.32 ± 0.95	1.60 ± 0.99	0.119
Placental thickness	2.64 ± 0.51	3.02 ± 0.57	< 0.001

A strong correlation was also found in the second trimester between the placental thickness and AC with r value 0.839 and p value < 0.001 (Table 3).

There was correlation between the placental thickness and the gestational age in the third trimester, with r value of 0.383 and p value of < 0.001. Statistically significant correlation is found between placental thickness and femur length in the third trimester, with a r value of 0.434 and a p value of < 0.001. Placental thickness with BPD and HC both shows statistically significant correlation with r value of 0.438, 0.307, respectively, and p value of < 0.001 and < 0.01, respectively (Table 3).

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

Discussion

Placental thickness is indicative of normal fetoplacental growth. As gestational age progresses placental thickness increases [12]. Thus, measuring placental thickness can help estimate gestational age. Additionally, it may help identify fetal abnormalities.

The aim of our study was to correlate placental thickness (PT) with gestational age (GA), biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC) using ultrasonography, in the second and third-trimester pregnancies. Additionally, we aimed to correlate placental thickness with expected fetal weight in predicting small for gestational age infants in our population. We found that placental thickness correlated with gestational age in both the second and third trimesters. We found that the placental thickness in the SGA group was lower as compared to the normal group.

We found that there was an increase in the thickness of the placenta as gestational age advances up to almost 35 weeks. From there, a minimal decrease in placental thickness was noticed from 36 to 39 weeks. Conversely, Mital et al. [13] found a steady increase in placental thickness up to 39 weeks. Jain et al. [14] like our findings, found a steady increase in placental thickness up to 28 weeks. Between 15 and 21 weeks of gestation, we found the placental thickness was higher than gestational age in weeks by 1 to 4 mm. Our findings were similar to those of Tiwari et al. [10] who showed that PT was higher than the gestational age by 1–4 mm up to 21 weeks of gestation. Ganjoo et al. [15] stated that the placental thickness was higher by 1.25 mm at 18 weeks and 2 mm at 19 weeks.

In our study, it was seen that there was a significant correlation between placental thickness and Gestational age, BPD, HC, AC, and FL. Karthikeyan et al. [16] in their study too found that there was a positive correlation between placental thickness and gestational age, BPD, HC, AC, and FL. Karthikeyan et al. [16] in their study state that since PT and GA have a linear relationship, PT can be used to substitute abnormal fetal growth parameters. For instance, they stated that in a fetus with hydrocephalus a subnormal BPD could be substituted with PT in addition to the other routine fetal growth parameters to estimate GA accurately. Since our study also showed a linear relationship between PT and GA, our results support the routine use of PT measurement on USG for accurate GA estimation. Placental thickness measurement can prove to be useful in cases with difficulty in assessing measurements like BPD and HC, like in large babies and late in the gestational period.

Studies have earlier shown that low placental thickness can predict low birth weight. Schwartz et al. [17] showed that the mean placental thickness and diameter taken in mid-gestation were significantly less in SGA babies. In our study, we showed that placental thickness in mid and late gestation was significantly less in SGA babies. Thus, the placental thickness can be important until late in the third trimester in predicting SGA babies.

There were some limitations in our study. Firstly, serial measurements of placental thickness were not taken. Secondly, all measurements were taken by a single observer. A larger sample size including more patients in each week of pregnancy can produce reference values that can be used in our routine practice.

Conclusions

Placental thickness has a strong correlation with gestation age as well as BPD, HC, and AC in the second and third trimesters. Placental thickness is significantly lower in small for gestational age babies. Routine measurement of placental thickness can help predict gestational age and detect small for gestational babies.

Abbreviations

AC	Abdominal circumference
APGAR	Appearance, pulse, grimace, activity, respiration
BPD	Biparietal diameter
Cm	Centimeter
CRL	Crown rump length
FL	Femur length
GA	Gestational age
HC	Head circumference
Kg	Kilograms
Mm	Millimeter
MSD	Mean sac diameter
OPD	Outpatient department
PT	Placental thickness
SGA	Small for gestational age
USG	Ultrasonography

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Not applicable.

Author contributions

KV performed the manuscript drafting and data collection of the placental thickness and biometric values in each trimester. SA oversaw the concept and visualization of exploring placental thickness as an additional fetal biometry parameter and manuscript review. PK carried out the manuscript review. VS contributed to the concept and visualization. AS analyzed and interpreted the patient data regarding the placental thickness and birth weight.
All authors read and reviewed the final manuscript.

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Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethics committee approval was obtained from the ethics committee, SRM MCH and RC. Ethical Clearance Number: 1469/IEC/2018. Written informed consent was obtained from all the participants for participation in the study and anonymous publication of data.

Consent for publication

Written informed consent was obtained from all the participants for anonymous publication of clinical data and study images. Names or data revealing

the patient identity or otherwise compromising anonymity are not present in the manuscript or images.

Competing interests
The authors declare that they have no competing interests.

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