

Original Research Article

A correlative study to evaluate the gestational age by sonological measurement of placental thickness in normal second and third trimester pregnancy

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ABSTRACT

Background: The dating of the pregnancy starts well before the fertilization has occurred because the gestational age is calculated from the first day of the last menstrual period (LMP). Accurate knowledge of the Gestational Age (GA) is the key for the good antenatal care and successful deliveries of babies. Menstrual history can be unreliable or misleading at many times. There may be fallacy in the measurement of the fetal biometric parameters in estimating the gestational age in some situation. So, there is a need of another parameter for supplementing the gestational age estimation with minimal error. The aim of the study was to evaluate the placental thickness as a parameter for estimation of gestational age and also to assess the growth pattern of placenta with advancing gestational age.

Methods: A total of 110 pregnant women who selected randomly from the antenatal clinics (between the gestational ages from 14 weeks to 40 weeks) who did not have any maternal or fetal complications. The biometric parameters: Biparietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), Femur Length (FL) and the Placental thickness (PT) were measured by ultrasound machine LOGIQ P5 unit with a curvilinear 3.5 MHz transducer. Mean value of the placental thickness along with the standard deviation (SD) and 95% confidence interval were calculated for each gestational age from 14 weeks to 40 weeks. Pearson's correlation analysis and linear regression analysis was done quantifying the relationship between the gestational age in weeks and the placental thickness in millimetres.

Results: The mean values of placental thickness show a perfect positive relationship (increasing trend) with gestational age and the mean value of placental thickness almost correspond to the gestational age till 35 weeks of the gestational age and fall marginally from 36 weeks. Placental thickness showed positive and significant correlation with gestational age (P-value<0.001) and Pearson's correlation coefficient (r) of 0.990.

Conclusions: Placental thickness can be an additional parameter for estimation of the gestational age as it almost corresponds with the gestational age in second and third trimesters. Also, any abnormal placental thickness for the particular gestational age should raise the suspicion of underlying fetal or maternal disease condition which can cause an increased or decreased in the placental thickness and should be addressed in time.

Keywords: Gestational age, Placenta, Ultrasonography

INTRODUCTION

Accurate knowledge of the Gestational Age (GA) is important for the good antenatal care and the successful deliveries of babies. The most useful information provided by the obstetrics ultrasound is the accurate

determination of the gestational age.¹ As significant numbers of pregnant women are unsure of their last menstrual period, determination of the gestational age mostly relies solely on sonographic measurements of the fetal parts such as the biparietal diameter (BPD), head circumference (HC), occipito-frontal diameter (OFD),

abdominal circumference (AC) and femur length (FL).² As sonography is user dependent it is prone to observer bias. The accuracy of the gestational age estimation by the measurement of various fetal parameters may be reduced depending upon the technical skill of observer, different techniques of measurement and the fetal position. So, there is a need of another parameter for supplementing the gestational age estimation with minimal error. Neonatal health is determined by few key factors: maternal health during pregnancy, normal genes, good placental implantation and feto-placental circulation. Normally functioning placenta is key factor for the normal fetal development and growth.³ The role of sonography in evaluation of the morphology and abnormalities of the placenta is well established. Placental size is the reflection of the fetal health and the growth. One additional parameter is used to assess the placenta is the placental size.

Sonographic measurement of the placental thickness is relatively simple, and it is clinically useful parameter. Placental thickness appears to be a promising parameter for estimation of gestational age of fetus. This is because there increase in thickness of the placenta with increasing gestational age. Few studies have been done to establish the role of the placental thickness as a parameter for evaluation of gestational age.⁴⁻⁶ Abnormal placental thickness is an indicator of various pathological conditions. Placental thickness can provide early indication of the fetus at risk and can contribute to the management.⁷

METHODS

The present study was a prospective cross-sectional study which was conducted in the Department of Radiodiagnosis and Imaging of Armed Forces Medical College, Pune from November 2014 to September 2016. Study was started after taking approval from the hospital ethical. 110 pregnant women, who were selected randomly from the antenatal clinics, met the inclusion criteria and willing to participate in study formed the study population (written consent was taken from all the cases).

Inclusion criteria

Normal antenatal women of gestational age from 14 weeks to 40 weeks presenting for regular antenatal checkup and referred for antenatal ultrasound were taken as study group. Informed consent was taken from all the patients.

Exclusion criteria

The following were excluded from the cases

- Fetal conditions: Congenital malformation, hydrops foetalis, multiple pregnancies and intrauterine growth restriction,

- Maternal conditions: Pregnancy induced hypertension, diabetes mellitus and other complications of pregnancy,
- Morphological variants of placenta and abnormal insertion of the umbilical cord,
- Unwilling patients.

Equipment and sonographic measurements

Measurements obtained using grey scale real time ultrasound examinations using an ultrasound machine LOGIQ P5 unit (GE Medical Systems, Milwaukee, Wisconsin, USA) with a curvilinear low frequency (3.5 MHz) transducer. The estimation of the gestational age was done by composite measurement of the following fetal parameters: Biparietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), and Femur Length (FL). These fetal biometric measurements were taken using the standardized technique. Estimated gestational age was computed by the ultrasound machine based on the Hadlock tables by the inbuilt computation software. Gestational age was estimated in number of weeks and days, and the days were further converted into the week for statistical analysis.

The placental thickness was measured at the level of the cord insertion. Transducer was oriented perpendicular to scan both the chorionic and basal plates. The measurement of the placental thickness was done in millimeters. Placental thickness was measured from the echogenic chronic plate to the myometrial interface and the myometrium and sub placental veins were excluded in the measurement.

Statistical analysis

Data collected was entered simultaneously into Microsoft excel worksheets designed appropriately. Statistical analysis was done using statistical package for social sciences (SPSS version 17.0) for MS Windows.

Analysis of data

The collected data was analyzed and the relationship between the placental thicknesses (mm) with the gestational age estimated from the fetal biometric parameters was evaluated. Also, the growth of the placenta with the advancing gestational age was studied.

The statistical analysis was done using the following methods

- Mean value of the placental thickness along with the standard deviation (SD) and 95% confidence interval were calculated for each gestational age from 14 weeks to 40 weeks.
- The growth pattern of the placenta with advancing gestational age was studied by plotting the graphs.

- The cases were further categorized into 5 groups as follows (14 to 20 weeks, 21 to 25 weeks, 26 to 30 weeks, 31 to 35 weeks and 36 to 40 weeks) and correlation analysis was done between the placental thickness and the gestational age for each of these groups along with calculation of the correlation coefficient for each of these groups. The Pearson's correlation analysis and linear regression analysis was done quantifying the relationship between the gestational age in weeks and the placental thickness in millimeters.

RESULTS

Maternal age distribution

A total of 110 antenatal women were recruited for the study between the gestation age of 14 weeks to 40 weeks. The age of the study population ranged from 19 years to 36 years. The mean \pm standard deviation of age of the entire group of cases studied is 25.3 ± 3.6 years. The demographic characteristics of the study population are presented in Table 1.

Table 1: Maternal age distribution of the cases studied (n=110).

Age group (years)	No. of cases	% of cases
<21.0	9	8.2
21.0-25.0	53	48.2
26.0-30.0	38	34.5
>30.0	10	9.1
Total	110	100.0

Gravity distribution

The cases were divided into primigravida, secundigravida and multigravida based on number of times they have been pregnant. Of 110 cases studied, 54 cases (49.1%) were primigravida, 46 cases (41.8%) were secundigravida and 10 cases (9.1%) were multigravida. The distribution of the cases based on the gravity is presented in Table 2.

Table 2: Distribution of gravity of the cases studied (n=110).

Gravity	No. of cases	% of cases
Primigravida	54	49.1
Secundigravida	46	41.8
Multigravida	10	9.1
Total	110	100.0

Distribution of placental location

Of 110 cases studied, 48 cases (43.6%) had anterior placenta, 35 cases (31.8%) had posterior placenta, 13 cases (11.8%) had fundal placenta and 14 cases (12.7%) had lateral location of the placenta. The distribution of the cases based on the gravity is presented in Table 3.

Table 3: Distribution of placental location of the cases studied (n=110).

Placental location	No. of cases	% of cases
Anterior	48	43.6
Posterior	35	31.8
Fundal	13	11.8
Lateral	14	12.7
Total	110	100.0

Relationship between gestational age and placental thickness

The calculation of the mean for each week of the gestational age was done and it was observed that the placental thickness gradually increases with the advancement of the gestational age. The mean placental thickness was 15.03 at 14 weeks of gestation and 36.65 mm at 40 weeks.

Placental thickness almost corresponds with the gestational age in weeks from 14-35 weeks of gestation and thereafter it was lesser by approximately 1-3 mm. In this study minimum placental thickness observed was 14.2 mm at and maximum placental thickness was 37.2 mm. The mean placental thickness for each week of the gestational age along with the 95% confidence interval is presented in Table 4.

Growth pattern of the placenta with advancing gestational age

Placental thickness of the cases studied has been plotted along with the gestational age and it is clear that there is a linear relationship between placental thickness (mm) and the gestational age (week). The mean values of placental thickness show a perfect positive relationship (increasing trend) with gestational age.

It shows that there is linear growth of the placenta with the advancing gestational age till 35 weeks of gestation and there is marginal fall in the growth of the placenta from 36 weeks of gestation. Further it is observed that 95% CI of placental thickness provide an interval of prediction of gestational age.

Relationship between gestational age and placental thickness in groups divided on the basis of the week of the gestational age

The studied cases were divided into the five groups (14 - 20 weeks, 21-25 weeks, 26-30 weeks, 31-35 weeks and 36-40 weeks) based on the week of the gestational age calculated from the ultrasonographic measurement of the fetal biometric parameters. The distribution of the cases into these groups is presented in Table 5. The mean placental thickness for groups with gestational age in weeks 14-20, 21-25, 26-30, 31-35 were 18.35, 23.62, 28.88 and 32.62 mm respectively which almost correspond to the mid-points of the gestational age

groups. However, the mean placental thickness for the group with gestational age in week 36-40 the mean placental thickness was 35.95 which were marginally

lower than the mean gestational age. The relationship between the gestational age and placental thickness in these groups are presented in Table 6.

Table 4: Mean placental thickness along with 95% CI of mean at each week of gestational age.

Gestational age (weeks)	No. of cases (n)	Placental Thickness (mm)		95% CI of mean
		Mean	SD	
14.0	3	15.03	0.80	13.04 – 17.03
15.0	4	16.40	0.47	15.65 – 17.14
16.0	4	16.57	0.46	15.85 – 17.30
17.0	4	17.75	1.23	15.80 – 19.70
18.0	4	19.25	0.66	18.21 – 20.29
19.0	3	19.97	0.40	18.96 – 20.97
20.0	8	20.68	0.52	20.26 – 21.12
21.0	4	21.97	0.30	21.50 – 22.45
22.0	3	22.77	0.85	20.65 – 24.88
23.0	4	23.87	0.45	23.16 – 24.59
24.0	3	24.87	0.40	23.86 – 25.87
25.0	2	25.80	0.57	20.72 – 30.88
26.0	3	27.03	0.25	26.41 – 27.66
27.0	3	28.00	0.79	26.03 – 29.97
28.0	4	28.10	1.22	26.16 – 30.04
29.0	4	29.37	1.16	27.54 – 31.21
30.0	6	30.42	0.73	29.65 – 31.19
31.0	7	30.60	1.24	29.45 – 31.75
32.0	6	32.38	0.70	31.64 – 33.12
33.0	6	32.58	0.97	31.56 – 33.60
34.0	6	34.00	0.82	33.14 – 34.86
35.0	3	35.13	1.05	32.52 – 37.74
36.0	3	35.13	0.31	34.37 – 35.89
37.0	3	35.30	0.26	34.64 – 35.96
38.0	4	36.05	0.17	35.77 – 36.33
39.0	4	36.43	0.45	35.71 – 37.14
40.0	2	36.65	0.78	29.66 – 43.64

Table 5: Distribution of cases studied (n=110) into the group based on the weeks of the gestational age.

Gestational age (weeks) by USG	No. of cases	% of cases
14.0 – 20.0	30	27.3
21.0 – 25.0	16	14.5
26.0 – 30.0	20	18.2
31.0 – 35.0	28	25.5
36.0 – 40.0	16	14.5
Total	110	100.0

Pearson's correlation analysis between the placental thickness and gestational age was also done for the groups divided based on the gestational age which is presented in Table 7.

In each gestational age group, the placental thickness showed positive and significant correlation with

gestational age (P-value<0.001 for all groups). Overall, the placental thickness showed positive and significant correlation with gestational age (P-value<0.001) and Pearson's correlation coefficient (r) of 0.990.

Table 6: Mean placental thickness along with 95% CI of mean at each group.

Gestational age (weeks)	No. of cases (n)	Placental Thickness (mm)		95% CI of mean
		Mean	SD	
14.0 – 20.0	30	18.35	2.09	17.56 – 19.13
21.0 – 25.0	16	23.62	1.42	22.86 – 24.38
26.0 – 30.0	20	28.88	1.49	28.17 – 29.58
31.0 – 35.0	28	32.62	1.74	31.95 – 33.29
36.0 – 40.0	16	35.91	0.67	35.55 – 36.26

Linear regression analysis for predicting the gestational age based on the placental thickness

The linear regression analysis for the prediction of gestational age by USG based on placental thickness is shown in Table 8.

Table 7: The correlation analysis showing the relationship between placental thickness and gestational age.

Gestational age (weeks)	Correlation between placental thickness and gestational age		
	N	Correlation coefficient (r)	P-value
14.0 – 20.0	30	0.951	0.001***
21.0 – 25.0	16	0.929	0.001***
26.0 – 30.0	20	0.816	0.001***
31.0 – 35.0	28	0.805	0.001***
36.0 – 40.0	16	0.851	0.001***
Overall	110	0.990	0.001***

Values are Pearson's correlation coefficient (r) and P-values. ***P-value<0.001.

Table 8: Linear regression analysis for predicting the gestational age based on the placental thickness.

Variable in the model	Beta Coefficient	Standardized Beta	P-value	R ² value (%)
Constant	-2.420	--	0.001***	98.1%
Placental Thickness (mm)	1.101	0.990	0.001***	

Dependent variable: Gestational age. ***P-value<0.001.

The equation for prediction based on regression analysis is given below

$$Y (\text{Gestational age}) = -2.42 + 1.101 \times \text{Placental Thickness.}$$

By this equation the gestational age can be predicted from the measurement of the placental thickness.

DISCUSSION

The ultrasonographic measurement of the placental thickness during the antenatal ultrasound has been described previously. However, to determine whether a measured placental thickness is normal or abnormal for that gestational age, normal range of the placental thickness must be defined for each week of the gestation.

In this study the relationship of the placental thickness measured in millimeters and the sonographic gestational age in week was evaluated.

In this study the analysis of the collected data showed that the placental thickness has significant positive correlation with the gestational age. The placental

thickness increases gradually with the gestational age in linear fashion from 14-35 weeks of gestation and increase in the placental from 36 weeks to 40 weeks fall gradually and it lags behind the gestation age marginally by 1-3mm.

The finding of this study that placental thickness increases with the advancing gestational age and placental thickness shows significant positive correlation is consistent with the result of the previous studies.

Nyberg and Finberg reported that the placental thickness in millimeters parallels the gestational age.⁹ In the present study also, the placental thickness almost parallels with the placental thickness till 35 weeks of gestation after which it falls by 1-3mm than the gestational age.

Jain A et al in their study observed that the mean placental thickness increased with advancing gestational age, almost matching from 27-33 weeks of gestation.¹⁰ Also, Mital P et al found the value of mean placental thickness increases with advancing gestational age and the placental thickness coincide almost exactly with the gestational age in weeks from the 22nd-35th week of gestation.

In the study done by Ohagwu CC et al in the pregnant Nigerian women in the second and third trimester showed that placental thickness increased with gestational age in a fairly linear manner and significant positive correlation was seen between the placental thickness and fetal biometric parameters (BPD and AC) in the second and third trimester. This relationship suggested that placental thickness can be used as an indicator of gestational age.¹¹

Karthikeyan T et al studied the correlation of the placental thickness and fetal gestational age, values were expressed in mean \pm standard deviation and Pearson's correlation analysis was done.⁴ There was a strong positive correlation between the gestational age and the placental thickness with the correlation coefficient, $r = 0.968$, which was significant at a 5% confidence interval.

Also from the values calculated for mean placental thickness for each gestational week it was evident that the placental thickness increases with advancing gestational age in almost linear fashion.

Grannum et al observed that there is gradual decrease in the placental size after 32 weeks of gestation till term.¹² In the present study the placental thickness decreased after 36 weeks of gestation.

Mathai BM et al study studied the correlation of the placental thickness measured with gestational age in normal and IUGR pregnancies and observed a positive correlation between placental thickness and gestational age in both normal and IUGR groups (p value of 0.01), with Pearson's correlation coefficient ("r") values of 0.325 in normal and 0.135 in IUGR pregnancies.

The placental thickness was also found to be lower in the group where postpartum fetal weight of baby weights < 2,500gm between 26 and 27 weeks and 30 and 31 weeks.¹³ The finding of the study in the normal pregnancy was comparable to the present study.

From the above discussion it is evident that placental thickness increases almost in linear fashion with the gestational age and has significant positive correlation with the gestational age and can be used as a predictor of the gestational age. These results were in accordance with several other studies as discussed above. Also, the abnormal placental thickness (increased or decreased placental thickness) for a particular gestational can be a predictor of the abnormal fetal or maternal condition.

Limitations of study was to present study is a cross sectional study and the placental thickness was measured only once in each subject during the study. So, it may not provide the clear understanding of placental growth pattern of individual cases. However, it is the approximate reflection of the placental growth pattern with increasing gestation age. To study the actual placental growth pattern serial measurement of the placental thickness of the cases at each week of the gestation has to be done and the growth curve can be studied.

The sample size in the present study is small to generate the nomogram of placental thickness for each gestational week. Also, the placental thickness may vary among the different group of population. So, a study with larger sample size including the cases from different population is required to create a nomogram of the placental thickness.

Since the ultrasound measurement was done by a single observer, there was a chance for an observer bias (intra observer variability). Also, there may be instrumental bias while taking various measurements.

CONCLUSION

Placental thickness increases with the advancing gestational age in linear fashion and there is significant positive correlation between the placental thickness and the gestational age. So, it can be concluded that placental thickness can be used as a predictor of the gestational age in those pregnant women in whom the LMP is unreliable or is not known. Optimal imaging for the measurement of the fetal biometric may be difficult at times like in late pregnancy with abnormal lie, when fetal head is deep in the maternal pelvis, multiple gestation or maternal obesity in such cases placental thickness can be used for estimation of the gestational age. Placental thickness can be an additional parameter for estimation of the gestational age as it almost corresponds with the gestational age. Any abnormal placental thickness for the particular gestational age should raise the suspicion of underlying fetal or maternal disease condition which can

cause an increased or decreased in the placental thickness and should be addressed in time.

A large series of longitudinal study including various study population is required for creating the nomogram of the placental thickness for each gestational week.

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