Section: Radiology

Original Research Article

ASSESSMENT OF PLACENTAL THICKNESS FOR PREDICTION OF GESTATIONAL AGE IN SECOND AND THIRD TRIMESTER OF SINGLETON PREGNANCIES.

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Received *: 25/10/2024*
Received in revised form *: 08/12/2024*
Accepted *: 24/12/2024*

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DOI: 10.70034/ijmedph.2025.1.4

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (1); 17-22

ABSTRACT

Background: Fetal biometry (including biparietal diameter, head circumference, abdominal circumference and femur length) is typically used for gestational age estimation but has limitations in cases of fetal anomalies or uncertain dating. Placental thickness can be used as an independent marker for gestational age. It correlates strongly with pregnancy progression and is less affected by fetal abnormalities. This study investigates its utility in the second and third trimesters.

Material and Methods: This observational study analyzed the utility of placental thickness as an independent marker for gestational age estimation in 80 pregnant women during their second and third trimesters. In call cases detailed history including menstrual history was obtained. Ultrasound evaluation and placental imaging were conducted to assess placental thickness and characteristics. Placental thickness was measured at the mid-placental level and correlation between placental thickness and gestational age was analysed. SSPS 23.0 software was used for statistical analysis and p value less than 0.05 was taken as statistically significant.

Results: The majority of cases enrolled in the study were aged between 18-25 years (37.5%) with a mean age of 27.28 ± 5.20 years. Most pregnancies were between 25-30 weeks of gestation (35.83%), and anterior placental location was most common (46.67%). Placental thickness showed a strong positive correlation with gestational age during 13-24 weeks (R=0.9818) and 25-37 weeks (R=0.9948). This correlation was found to be statistically highly significant (P<0.00001). In late-term pregnancies (38-42 weeks) a moderate negative correlation (R=-0.7135) was observed but it was statistically insignificant (P=0.176).

Conclusion: Placental thickness showed a strong positive correlation with gestational age during 13-37 weeks making it a reliable marker for gestational age estimation. However, this relationship weakened and became insignificant in late-term pregnancies (38-42 weeks).

Key Words: Gestational Age Estimation, Placental Thickness, Fetal Biometry, Ultrasound.

INTRODUCTION

The accurate determination of fetal gestational age is an important part of antenatal care and serves as an important determinant for monitoring fetal development and optimizing maternal and neonatal outcomes.[1] Precise gestational age estimation is essential for decisions such as antenatal corticosteroid administration, induction of labor and scheduling of elective caesarean section. Estimation of fetal gestational age is an important determinant of perinatal outcome since premature babies are more prone to develop complications such as neonatal seizures, birth asphyxia and respiratory distress

syndrome secondary to hyaline membrane disease.[2] Errors in gestational age estimation can lead to adverse outcomes including inappropriate timing of delivery and associated complications.[3]

Ultrasound imaging provides a non-invasive method for gestational age estimation. Ultrasound relies on fetal biometric parameters including crown-rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). In the first trimester, CRL is recognized as the most reliable metric for gestational dating. In the second and third trimesters, BPD, HC, AC, and FL are primarily used to refine gestational age estimation. Advanced algorithms integrating these measurements have further improved precision.[4]

Though in most of cases ultrasound can be considered as gold standard method of determination of gestational age there are clinical scenarios where reliance on biometric parameters alone may lead to inaccuracies. Crown-rump length measurements cannot be relied upon in pregnancies with delayed ovulation or uncertainty about last menstrual periods. Biparietal diameter and head circumference may not accurately estimate gestational age in cases hydrocephalus or microcephaly.[5] Abdominal circumference measurements are influenced by conditions such as diaphragmatic hernia and intrauterine growth restriction. Femur length may be unreliable in cases of skeletal dysplasias or other congenital causes of short stature. The limitations of biometric parameters in these situations necessitates use of independent markers for gestational age determination. Recent interest has focused on the placenta which undergoes predictable morphological changes throughout pregnancy. Placental thickness has emerged as a potential marker for gestational age estimation that can be relied upon in situation where fetal biometry cannot be wholly relied upon.[6]

Placental thickness demonstrates a strong positive correlation with gestational age in cases of uncomplicated pregnancies. Ultrasound measurement of placental thickness at the mid-placental level reflects the growth and maturation of the placenta as pregnancy advances.[7] Unlike fetal biometric parameters placental thickness is less likely to be influenced by fetal growth abnormalities or structural anomalies which makes it a reliable marker for independent gestational age estimation. The potential of placental thickness to serve as a reliable alternative to biometric parameters such as BPD, HC, AC, and FL has aroused significant interest amongst researchers.[8]

Despite its utility the role of placental thickness as an independent marker for gestational age remains relatively underexplored.9 Moreover, there is a lack of standardized protocols for estimating gestational age from placental thickness measurement and validated algorithms for such use of placental thickness as a marker for gestational age estimation also need to be developed yet.[10] We therefor undertook this study to address these gaps by analyzing the correlation between placental thickness and gestational age in 2nd and 3rd trimester of pregnancy.

MATERIALS AND METHODS

This was an observational study conducted in the department of radiology of a tertiary care medical institute. 80 pregnant women in their 2nd and 3rd trimester of pregnancy were included in this study after applying a predefined inclusion and exclusion criteria. The purpose of this study was to analyse the utility of placental thickness as an independent marker of estimation of gestational age in 2nd and 3rd trimester of pregnancy. The duration of study was 6 months. Since this was a purely observational study and no interventions were involved institutional ethics committee approval was not required. Informed and written consent was obtained from all the participants before enrolling them in this study. Sample size determination was done on the basis of studies that were done on the topic of utility of placental thickness for gestational age estimation. Epi-version 3.01 online software was used which showed a minimum sample size of 75 patients needed for this study therefor we included 80 patients in our study.

A detailed history was obtained from all the participants of the study including the the date of last menstrual period and menstrual history prior to conception. History of diseases which may manifest as irregular menses including history of polycystic ovarian syndrome, thyroid function abnormalities and any system illness, which may affect growth of fetus, such as hypertension or diabetes was asked for and noted. In the beginning gestational age was determined on the basis of last menstrual period. After recording this data an antenatal ultrasound was done by a senior radiologist. The ultrasound machine used was GE Versana Balance. Antenatal scans were done using convex probe.

Presentation and lie were first analysed by ultrasound. Amniotic fluid index was determined by using the four-quadrant method. Any gross congenital anomaly was documented. Fetal weight and gestational age estimation was performed using biometric parameters such as head circumference, biparietal diameter, abdominal circumference and femur length. Placental imaging was performed and assessment of placental location was done. Placental abnormalities, including abnormal shape, infarction, calcifications and morphological issues such as chorioangioma, placental lakes, fibrin deposition and intervillous thrombosis were assessed. Additionally, conditions like bilobed placenta, succenturiate lobe, velamentous cord insertion, circumvallate placenta, low-lying placenta and placenta previa were evaluated. Placental thickness was measured near umbilical cord insertion at midplacental level, and mean values with standard deviations were recorded

at various gestational ages in the second and third trimesters.

Statistical analysis was performed using SPSS version 23.0 software. Quantitative data, such as mean placental thickness measurements at various gestational ages was presented as mean ± standard deviation. Qualitative data, including the presence of placental abnormalities such as shape irregularities or site-related issues were represented by incidence and percentage tables. For comparisons of placental thickness between different gestational age groups the unpaired t-test was applied. The pearsons co-efficient was used to analyze the relationship placental thickness and gestational age. A p-value of less than 0.05 was considered statistically significant indicating meaningful correlations in placental thickness measurements as a marker for gestational age.

Inclusion Criteria

1. Pregnant women presenting in 2nd and 3rd trimester of pregnancy.
2. Age Above 18 years.
3. Ready to give informed and written consent to be part of study.

Exclusion Criteria

1. 1st trimester and post-term (above 42 weeks) pregnancies.
2. Age below 18 years.
3. Those who refused consent to be part of study.
4. Cases in whom date of last menstrual period is not known.
5. Fetuses with congenital anomalies and syndromes.
6. Significant maternal systemic illnesses such as hypertension, diabetes and eclampsia.

RESULTS

The analysis of maternal age distribution among the studied cases revealed that the majority of mothers were between 18-25 years (7.50%) followed by 26-30 years, (35.00%) and 31-35 years (20.00%), while the least representation was observed in mothers aged over 35 years (7.50%). The mean age of studied cases was found to be 27.28 +/- 5.20. [Table 1]

The analysis of gestational age of the studied cases showed that majority of cases were between 25-30 weeks (35.83%), followed by 31-37 weeks (31.67%) and 14-24 weeks (22.50%). Only 8 (10%) cases were between 38-42 weeks of gestation. [Table 2]

The analysis of placental location among the studied cases showed that the majority of placentas were located anteriorly (46.67%), followed by posterior locations (31.67%) and fundal locations (11.67%). Fewer cases had right lateral (5.83%) and left lateral (4.17%) placental locations. [Figure 1]

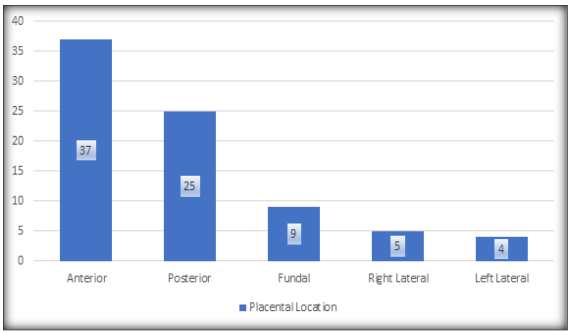

Figure 1: Placental Location in studied cases.

The analysis of the relationship between the lower end of the placenta and the internal os revealed that the placenta was away from the os in 61 cases (75.83%), followed by low-lying placentas in 17 cases (21.67%), and placenta previa in 2 cases (2.50%). [Table 4]

The analysis of the correlation between gestational age and placental thickness showed a positive linear relationship indicating that as gestational age increased placental thickness also increased. Placental thickness was approximately 15.56 mm at 14 weeks and steadily rose to around 36-37 mm by term (37 weeks). [Table 5]

The analysis of the correlation between placental thickness and gestational age during 13-24 weeks of gestation demonstrated a strong positive relationship, with a correlation coefficient (R) of 0.9818. This association was statistically highly significant ($P<0.00001$). [Table 6]

The analysis of the correlation between placental thickness and gestational age during 25-37 weeks of gestation revealed a very strong positive relationship, with a correlation coefficient (R) of 0.9948. This association was statistically highly significant ($P<0.00001$). [Table 7]

The analysis of the correlation between placental thickness and gestational age during 38-42 weeks of gestation showed a moderate negative relationship, with a correlation coefficient (R) of -0.7135. However, this association was not statistically significant, as indicated by a p-value of 0.176. This suggests that while there is a moderate inverse trend between placental thickness and gestational age in this period. Moreover, this relationship lacked statistical significance. [Table 8]

Table 1: Maternal age in studied cases

Maternal Age	Number of Cases	Percentage
18-25 years	30	37.50%
26-30 years	28	35.00%
31-35 years	16	20.00%
> 35 years	6	7.50%
Total	80	100%
Mean Age = 27.28 +/- 5.20		

Table 2: Gestational age in studied cases

Gestational Age	Number of Cases	Percentage
14-24 weeks	18	22.50%
25-30 weeks	29	35.83%
31-37 weeks	25	31.67%
38-42 weeks	8	10.00%
Total	80	100%

Table 3: Distance of lower end of placenta from internal Os

Placental Distance from Internal Os	Number of Cases	Percentage
Away from Os	61	75.83%
Low-lying	17	21.67%
Placenta Previa	2	2.50%
Total	80	100%

Table 4: Correlation of Placental thickness and gestational age

GA	Placental Thickness (mm)
13	15.12
14	15.58
15	16.22
16	17.89
17	18.98
18	19.79
19	20.42
20	21.68
21	21.82
22	21.87
23	22.45
24	23.57
25	24.74
26	25.43
27	27.08
28	28.25
29	29.18
30	29.73
31	31.04
32	31.74
33	33.01
34	34.89
35	35.19
36	35.25
37	36.95
38	36.82
39	36.74
40	36.80
41	36.68
42	36.72

Table 5: Correlation between Placental Thickness and Gestational Age (13-24 Weeks)

Parameter	Value
Correlation Coefficient (R)	0.9818
P-Value	< 0.00001*
Conclusion	Strong positive correlation

Table 6: Correlation between Placental Thickness and Fetal Weight (25-37 Weeks)

Parameter	Value
Correlation Coefficient (R)	0.9948.
P-Value	< 0.00001*
Conclusion	Strong positive correlation

Table 7: Correlation between Placental Thickness and Fetal Weight (38-42 Weeks)

Parameter	Value
Correlation Coefficient (R)	-0.7135
P-Value	0.176
Conclusion	Moderate Negative Relationship

DISCUSSION

The most common methods for determining gestational age rely on clinical history as well as on ultrasonographic assessment of gestational age by fetal biometry.[11] Clinical estimation uses the first day of the last menstrual period (LMP). However, this approach is prone to errors in cases of irregular

cycles, delayed ovulation or uncertainty about LMP. Ultrasonography employs fetal biometric parameters such as crown-rump length (CRL) in the first trimester, and biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) in the second and third trimesters.[12] While these methods are generally reliable there are scenarios where they cannot be wholly relied upon. CRL may not be reliable in pregnancies with delayed conception or uncertain dating. Fetal biometric parameters such as BPD and HC can not be relied upon in cases of hydrocephalus or microcephaly. Similarly, AC can be affected by growth abnormalities such as intrauterine growth restriction (IUGR) or congenital anomalies like diaphragmatic hernia.[13] Femur length may not accurately reflect gestational age in conditions such as congenital skeletal dysplasias and conditions associated with short stature. Because of unreliability of fetal biometry in assessment of gestational age in these conditions there is a need to have an alternative or adjunctive markers such as placental thickness which is less likely to be influenced by fetal anomalies.[14]

In our study gestational age and placental thickness showed a positive linear relationship indicating that as gestational age increased placental thickness also increased. Placental thickness was approximately 15.56 mm at 14 weeks and steadily increased to around 36.95 mm by term (37 weeks). T. Karthikeyan et al. conducted a cross-sectional ultrasonographic study to assess the correlation between placental thickness, gestational age, and fetal growth parameters.[15] For this purpose, the authors undertook a study comprising 300 pregnant women with normal singleton pregnancies between 12 and 40 weeks of gestation. Placental thickness was measured at the level of the umbilical cord insertion using ultrasonography, and its relationship with gestational age and fetal growth parameters was analyzed. The study found that placental thickness increased linearly with advancing gestational age, showing a strong positive correlation ($r = 0.98$, $p < 0.001$). Additionally, placental thickness demonstrated significant correlations with fetal growth parameters such as biparietal diameter, femur length, and abdominal circumference. On the basis of these findings, the authors concluded that placental thickness could serve as a reliable indicator for estimating gestational age and assessing fetal growth during pregnancy. Similar correlation between placental thickness and gestational age was also reported by the authors such as Mital P et al,[16] and Shepard MJ et al.[17]

In our study, we observed a strong positive correlation between placental thickness and gestational age during the second and third trimesters (14-37 weeks), supporting its utility as an independent marker for estimating gestational age. However, in the late third trimester (38-42 weeks), this relationship diminished, with a moderate negative correlation that lacked statistical significance. These findings highlight the potential and limitations of placental thickness as a standalone parameter for gestational dating. Ohagwu CC et al. conducted a prospective study to investigate placental thickness as a parameter for estimating gestational age in normal singleton pregnancies.[18] For this purpose, the authors undertook a study comprising 730 women with normal singleton pregnancies. Gestational age was estimated using crown-rump length (CRL), biparietal diameter (BPD), femur length (FL), and abdominal circumference (AC), with the composite average recorded. Placental thickness was measured at the point of insertion of the umbilical cord, and mean placental thickness with standard deviation was calculated for each gestational age. Correlation and regression analyses were used to assess the relationship between placental thickness and gestational age. The study found that the maximum mean placental thickness of 45.1 ± 6.4 mm was recorded at 39 weeks of gestation. There was a fairly linear increase in mean placental thickness with gestational age, and a strong positive correlation was observed between placental thickness and gestational age.On the basis of these findings, the authors concluded that placental thickness appears promising as an accurate indicator of gestational age in singleton pregnancies. Similar findings were also reported by the authors such as Rawal S et al,[19] and Sharami SH et al.[20]

While our study confirms the reliable correlation between placental thickness and gestational age between 14-37 weeks discrepancies in late-term pregnancies suggest that additional parameters may be needed to refine gestational age predictions after 37 weeks of gestation. Notably our study adds to the growing evidence that shows a significant positive correlation between placental thickness and gestational age it also underscores the necessity for larger, multicentric studies to develop validated algorithms for clinical implementation.

CONCLUSION

There was a strong positive correlation between placental thickness and gestational age during the second and third trimesters of pregnancy indicating that placental thickness can serve as a reliable marker for estimating gestational age. The correlation was highly significant during these periods. However, in late-term pregnancies (38-42 weeks) the relationship became moderately negative and statistically insignificant, suggesting a plateau or decline in placental growth as pregnancy progresses toward term.

Conflict Of Interest: None.

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