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Fetal Gestational Age Determination Using Ultrasound Placental Thickness In Tertiary Care Hospital Of Central India

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Abstract

Background: Accurate determination of fetal gestational age is essential for monitoring fetal growth, scheduling antenatal investigations and planning obstetric management. Gestational age is commonly estimated from the last menstrual period and conventional fetal biometric measurements. However, these methods may be less reliable when menstrual dates are uncertain or fetal biometric measurements are technically difficult. Ultrasonographic placental thickness may provide an additional simple parameter for estimating gestational age.***Aim:*** To determine fetal gestational age using ultrasonographic placental thickness and assess its correlation with gestational age calculated from the last menstrual period and standard fetal biometric parameters.***Materials and Methods:*** This hospital-based analytical cross-sectional study included 400 pregnant women with normal singleton pregnancies between 15 and 40 weeks of gestation who were referred for routine obstetric ultrasonography at People's Hospital, Bhopal. Data were collected from 1 April 2024 to 31 December 2025 through consecutive sampling. Ultrasonography was performed using Siemens ACUSON NX2 or Voluson S6 machines. Fetal biparietal diameter, femur length and abdominal circumference were recorded, followed by measurement of placental thickness in millimetres at the level of umbilical cord insertion. Gestational age was estimated by fetal biometry and the last menstrual period. ***Results:*** The mean maternal age was 27.89 ± 3.34 years, and 48.25% of participants were aged 18–25 years. Second gravida women constituted the largest parity group at 43.00%. Placental thickness increased progressively from 15.61 ± 0.49 mm at 15 weeks to 39.69 ± 0.81 mm at 40 weeks. The overall correlation between placental thickness and gestational age was strong and statistically significant ($r = 0.909$, $p < 0.00001$). Based on fetal biometry, correlation coefficients were 0.884 in the second trimester and 0.998 in the third trimester. Based on the last menstrual period, the corresponding correlations were 0.754 and 0.995, respectively, with all associations being statistically significant.***Conclusion:*** Placental thickness increased consistently with advancing gestational age and showed a strong positive correlation with gestational age estimated by fetal biometry and the last menstrual period. Ultrasonographic placental thickness may therefore serve as a simple, reliable and useful supplementary parameter for fetal gestational-age assessment, particularly during the third trimester.

Keywords: Placental thickness; Gestational age; Ultrasonography; Fetal biometry; Last menstrual period.

INTRODUCTION

Accurate determination of fetal gestational age is an essential component of antenatal care because it provides the framework for evaluating fetal development and planning obstetric management. Reliable dating is required for the correct timing of screening examinations, interpretation of fetal growth, recognition of preterm and post-term pregnancy and

scheduling of medically indicated delivery. An incorrect estimate may lead to inappropriate classification of fetal size or delayed recognition of complications. International recommendations therefore recognise antenatal ultrasonography as an essential method for confirming gestational age and assessing the fetus, placenta and surrounding structures.[1] Gestational age is traditionally calculated from the first day of the last menstrual period. Although this method is widely available, its accuracy depends on regular menstrual cycles, reliable maternal recall and correct identification of the last normal period. Irregular cycles, lactational amenorrhoea, implantation bleeding and uncertainty regarding menstrual dates may reduce its reliability. Ultrasound dating is consequently preferred when menstrual information is unavailable or inconsistent. During early pregnancy, crown–rump length is the principal biometric parameter, while later examinations use biparietal diameter, head circumference, abdominal circumference and femur length.[2] Routine mid-trimester ultrasonography permits assessment of fetal anatomy, viability, growth, amniotic fluid and placental location in addition to gestational dating. However, the precision of conventional fetal biometric dating decreases as pregnancy advances because biological variation in fetal size becomes more prominent. Measurements may also be affected by fetal position, abnormal head shape, skeletal abnormalities, growth restriction or technical difficulty. Third-trimester evaluation therefore requires integration of menstrual history, earlier scans and multiple biometric observations. Additional sonographic markers may strengthen gestational assessment, particularly in women presenting late for antenatal care.[3,4] The placenta is a temporary but highly specialised fetomaternal organ that supports fetal growth through gas exchange, nutrient transfer, waste elimination, endocrine activity and immunological regulation. Its structure changes continuously as pregnancy progresses, reflecting expansion of the villous tree, vascular development and increasing fetal demands. Ultrasonography permits non-invasive examination of placental location, morphology, echogenicity and dimensions. Placental thickness is a simple two-dimensional measurement that can be obtained during routine obstetric scanning without specialised software or substantial additional examination time.[5] Placental thickness is generally measured in millimetres at or near the umbilical cord insertion, with the ultrasound beam directed perpendicular to the chorionic and basal plates. The myometrium and retroplacental vessels should be excluded, and excessive transducer pressure should be avoided. Standardised technique is important because placental position, uterine contraction, oblique insonation and inclusion of adjacent tissues may alter the recorded value. Placental thickness has therefore been proposed as an adjunctive indicator of placental development, fetal growth and gestational age in normal singleton pregnancies. [6]

MATERIALS AND METHODS

A hospital-based analytical cross-sectional study was conducted among pregnant women with singleton pregnancies who were referred from the Department of Obstetrics and Gynaecology, People's Hospital, Bhopal, for routine obstetric ultrasonography. Pregnant women between 15 and 40 weeks of gestation were selected for the study. A total of 400 pregnant women were included. The independent variables were maternal age and parity, while the dependent variables were placental thickness, gestational age calculated from the last menstrual period, and gestational age estimated using other fetal biometric parameters.

Inclusion Criteria

Pregnant women with normal singleton pregnancies between 15 and 40 weeks of gestation were included in the study. Women with a history of regular menstruation and a known last menstrual period were considered eligible.

Exclusion Criteria

Pregnant women with hypertensive disorders, diabetes mellitus, anaemia, intrauterine growth restriction, multiple pregnancies, fetal anomalies, irregular menstruation, unknown last menstrual period, or placental abnormalities were excluded from the study.

Apparatus and Materials

Ultrasonography was performed using Siemens ACUSON NX2 or Voluson S6 machines equipped with a 2–5 MHz curvilinear probe, a 5–10 MHz linear probe, and a 5–11 MHz transvaginal probe.

Data Collection Procedure

Data were collected by consecutive sampling of pregnant women attending the ultrasonography outpatient department between 1 April 2024 and 31 December 2025. B-mode ultrasonography was performed with the patient in the supine position and with a moderately distended urinary bladder. Ultrasonographic gel was applied over the probe, which was then placed over the patient's abdomen.

The amniotic fluid index was first measured to rule out oligohydramnios and polyhydramnios. Thereafter, fetal biometric parameters, including biparietal diameter, femur length, and abdominal circumference, were recorded. Placental thickness was measured in millimetres at the level of the umbilical cord insertion.

Statistical Analysis

The collected data were analysed using IBM SPSS Statistics, version 27.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Correlation analysis was performed to assess the relationship between placental thickness and gestational age. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows the distribution of the 400 study participants according to maternal age, gestational age and parity. The largest proportion of participants belonged to the 18–25-year age group, comprising 193 cases (48.25%), followed by 137 cases (34.25%) in the 26–30-year age group. A total of 50 participants (12.50%) were aged 31–35 years, while 20 participants (5.00%) were older than 35 years. The mean maternal age of the study participants was 27.89 ± 3.34 years. According to gestational age, the highest number of participants was observed in the 15–20-week group, with 109 cases (27.25%), followed by 102 cases (25.50%) in the 31–35-week group. The 26–30-week gestational age group included 73 cases (18.25%), while the 21–25-week and 36–40-week groups each included 58 cases (14.50%). Regarding parity, second gravida women formed the largest group, accounting for 172 cases (43.00%). Third gravida women constituted 120 cases (30.00%), whereas primigravida women accounted for 108 cases (27.00%).

Table 2 presents the relationship between placental thickness and gestational age estimated by fetal biometry. In the second trimester, the mean placental thickness increased progressively from 15.61 ± 0.49 mm at 15 weeks to 30.10 ± 1.13 mm at 27 weeks. At 16 weeks, the mean placental thickness was 16.60 ± 0.48 mm, which increased to 18.77 ± 0.25 mm at 17 weeks, 19.20 ± 0.48 mm at 18 weeks and 20.22 ± 0.60 mm at 19 weeks. At 20 weeks, the mean placental thickness was 23.70 ± 0.65 mm. It further increased to 23.99 ± 0.60 mm at 21 weeks, 24.89 ± 0.37 mm at 22 weeks, 24.90 ± 0.47 mm at 23 weeks, 25.90 ± 0.45 mm at 24 weeks, 26.92 ± 0.87 mm at 25 weeks, 29.00 ± 0.83 mm at 26 weeks and 30.10 ± 1.13 mm at 27 weeks.

In the third trimester, the mean placental thickness based on fetal biometry was 29.30 ± 0.12 mm at 28 weeks and increased to 31.39 ± 1.18 mm at 29 weeks and 32.45 ± 1.29 mm at 30 weeks. At 31 and 32 weeks, the mean placental thickness was 32.80 ± 1.26 mm and 34.40 ± 0.75 mm, respectively. It further increased to 34.60 ± 0.99 mm at 33 weeks, 36.27 ± 0.88 mm at 34 weeks and 37.16 ± 1.48 mm at 35 weeks. At 36, 37 and 38 weeks, the mean placental thickness was 37.70 ± 0.28 mm, 37.87 ± 0.36 mm and 38.06 ± 0.26 mm, respectively. The mean thickness reached 38.46 ± 0.48 mm at 39 weeks and 39.69 ± 0.81 mm at 40 weeks.

Table 3 shows placental thickness according to gestational age calculated from the last menstrual period. In the second trimester, the mean placental thickness was 15.61 ± 0.49 mm at 15 weeks and 16.60 ± 0.48 mm at 16 weeks. It increased to 18.77 ± 0.25 mm at 17 weeks, 19.20 ± 0.48 mm at 18 weeks and 20.22 ± 0.60 mm at 19 weeks. At 20 weeks, the mean placental thickness was 23.70 ± 0.65 mm. The corresponding values at 21, 22, 23 and 24 weeks were 23.99 ± 0.60 mm, 24.89 ± 0.37 mm, 24.90 ± 0.47 mm and 25.90 ± 0.45 mm, respectively. At 25 weeks, the mean placental thickness was 26.92 ± 0.87 mm, which further increased to 29.00 ± 0.83 mm at 26 weeks and 30.10 ± 1.13 mm at 27 weeks.

During the third trimester, the mean placental thickness based on the last menstrual period was 30.35 ± 0.12 mm at 28 weeks and 31.39 ± 1.18 mm at 29 weeks. It increased to 32.45 ± 1.29 mm at 30 weeks and 32.80 ± 1.26 mm at 31 weeks. At 32 and 33 weeks, the corresponding values were 34.40 ± 0.75 mm and 34.60 ± 0.99 mm. The mean placental thickness was 36.27 ± 0.88 mm at 34 weeks and 37.16 ± 1.48 mm at 35 weeks. At 36, 37 and 38 weeks, the mean values were 37.70 ± 0.28 mm, 37.87 ± 0.36 mm and 38.06 ± 0.26 mm, respectively. The mean placental thickness increased to 38.46 ± 0.48 mm at 39 weeks and 39.69 ± 0.81 mm at 40 weeks.

Table 4 presents placental thickness and its correlation with gestational age across different gestational-age groups. Among women at 15–20 weeks of gestation, the mean placental thickness was 20.42 ± 4.12 mm, and a very strong positive correlation was observed between placental thickness and gestational age, with a correlation coefficient of 0.98 and a p-value of less than 0.00001. In the 21–25-week group, the mean placental thickness was 26.66 ± 3.47 mm, with a strong positive correlation of 0.902, which was also statistically significant. In the 26–30-week group, the mean placental thickness was 32.93 ± 4.54 mm, and the correlation coefficient was 0.803. Among participants at 31–35 weeks, the mean placental thickness was 37.68 ± 4.78 mm, with a correlation coefficient of 0.80. In the 36–40-week group, the mean placental thickness was highest at 46.94 ± 3.71 mm, and the correlation coefficient was 0.82. All gestational-age groups showed statistically significant positive correlations, with p-values of less than 0.00001.

Table 5 demonstrates the Pearson correlation between placental thickness and gestational age in the second and third trimesters based on fetal biometry. In the second trimester, 193 participants were included, with a mean value of 14.12 ±

0.58. The correlation coefficient between placental thickness and gestational age was 0.884, indicating a strong positive correlation, which was statistically significant with a p-value of less than 0.00001. In the third trimester, 198 participants were included, with a mean value of 31.18 ± 5.52. The correlation coefficient was 0.998, indicating an almost perfect positive correlation between placental thickness and gestational age. This association was also highly statistically significant, with a p-value of less than 0.00001.

Table 6 presents the Pearson correlation between placental thickness and gestational age in the second and third trimesters based on the last menstrual period. In the second trimester, 194 participants were included, with a mean value of 15.23 ± 0.57. A positive correlation was observed between placental thickness and gestational age, with a correlation coefficient of 0.754. This relationship was statistically significant, with a p-value of less than 0.00001. In the third trimester, 197 participants were included, with a mean value of 31.04 ± 5.26. The correlation coefficient was 0.995, indicating an almost perfect positive relationship between placental thickness and gestational age based on the last menstrual period. This correlation was also highly statistically significant, with a p-value of less than 0.00001.

Table 1: Distribution of study participants according to age group, gestational age and parity

Variable	Category	No. of Cases	Percentage
Age group (years)	18–25	193	48.25%
	26–30	137	34.25%
	31–35	50	12.50%
	>35	20	5.00%
	Total	**400**	**100.00%**
	Mean ± SD	**27.89 ± 3.34**	
Gestational age (weeks)	15–20	109	27.25%
	21–25	58	14.50%
	26–30	73	18.25%
	31–35	102	25.50%
	36–40	58	14.50%
	Total	**400**	**100.00%**
Parity	Primigravida	108	27.00%
	Second Gravida	172	43.00%
	Third Gravida	120	30.00%
	Total	**400**	**100.00%**

Table 2: Placental thickness and gestational age based on fetal biometry

Trimester	Gestational Age (weeks), Biometry	No. of Cases	Placental Thickness Mean (mm)	SD
II Trimester	15	8	15.61	0.49
	16	8	16.6	0.48
	17	4	18.77	0.25
	18	15	19.2	0.48
	19	30	20.22	0.6
	20	50	23.7	0.65
	21	16	23.99	0.6
	22	15	24.89	0.37
	23	9	24.9	0.47
	24	10	25.9	0.45
	25	16	26.92	0.87
	26	8	29	0.83
	27	15	30.1	1.13

III Trimester	28	14	29.3	0.12
	29	11	31.39	1.18
	30	13	32.45	1.29
	31	18	32.8	1.26
	32	22	34.4	0.75
	33	25	34.6	0.99
	34	18	36.27	0.88
	35	19	37.16	1.48
	36	9	37.7	0.28
	37	11	37.87	0.36
	38	10	38.06	0.26
	39	15	38.46	0.48
	40	13	39.69	0.81

Table 3: Placental thickness and gestational age based on last menstrual period

Trimester	Gestational Age (weeks), LMP	No. of Cases	Placental Thickness Mean (mm)	SD
II Trimester	15	8	15.61	0.49
	16	7	16.6	0.48
	17	3	18.77	0.25
	18	9	19.2	0.48
	19	26	20.22	0.6
	20	54	23.7	0.65
	21	17	23.99	0.6
	22	13	24.89	0.37
	23	12	24.9	0.47
	24	10	25.9	0.45
	25	15	26.92	0.87
	26	7	29	0.83
	27	13	30.1	1.13
III Trimester	28	12	30.35	0.12
	29	10	31.39	1.18
	30	11	32.45	1.29
	31	21	32.8	1.26
	32	19	34.4	0.75
	33	30	34.6	0.99
	34	16	36.27	0.88
	35	21	37.16	1.48
	36	12	37.7	0.28
	37	9	37.87	0.36
	38	10	38.06	0.26
	39	14	38.46	0.48
	40	12	39.69	0.81

Table 4: Placental thickness and its correlation with gestational age across different gestational-age groups

Gestational Age (weeks)	No. of Cases	Placental Thickness Mean (mm)	SD	Correlation Coefficient (r)	P-value
15–20	109	20.42	4.12	0.98	<0.00001
21–25	58	26.66	3.47	0.902	<0.00001
26–30	73	32.93	4.54	0.803	<0.00001
31–35	102	37.68	4.78	0.8	<0.00001
36–40	58	46.94	3.71	0.82	<0.00001
Overall	**400**			**0.909**	**<0.00001**

Table 5: Pearson correlation between placental thickness and gestational age in the second and third trimesters based on fetal biometry

Trimester	Sample Size	Mean	SD	Correlation Coefficient (r)	P-value
II	193	14.12	0.58	0.884	<0.00001
III	198	31.18	5.52	0.998	<0.00001

Table 6: Pearson correlation between placental thickness and gestational age in the second and third trimesters based on LMP

Trimester	Sample Size	Mean	SD	Correlation Coefficient (r)	P-value
II	194	15.23	0.57	0.754	<0.00001
III	197	31.04	5.26	0.995	<0.00001

DISCUSSION

The present study included 400 pregnant women with a mean maternal age of 27.89 ± 3.34 years. Nearly half of the participants were aged 18–25 years (48.25%), followed by 34.25% in the 26–30-year age group. Most women were second gravida (43.00%), while primigravida and third gravida women constituted 27.00% and 30.00%, respectively. The participants were distributed across 15–40 weeks of gestation, with the highest proportions recorded at 15–20 weeks (27.25%) and 31–35 weeks (25.50%). Olaleye et al. (2022), in a study of 406 pregnant women at 15–40 weeks of gestation, reported a comparatively higher mean maternal age of 31.8 ± 4.8 years. The younger maternal profile in the present study may reflect differences in the demographic and referral characteristics of the study populations.[7] Placental thickness estimated according to fetal biometry showed a progressive increase during the second trimester. It increased from 15.61 ± 0.49 mm at 15 weeks to 23.70 ± 0.65 mm at 20 weeks, 26.92 ± 0.87 mm at 25 weeks and 30.10 ± 1.13 mm at 27 weeks. Karthikeyan et al. (2012) similarly reported placental thicknesses of 18.28 ± 0.77 mm at 15 weeks, 22.40 ± 1.15 mm at 20 weeks, 27.73 ± 0.62 mm at 25 weeks and 31.73 ± 0.57 mm at 26 weeks. They observed an increase of more than 4 mm between 15 and 20 weeks and more than 5 mm between 20 and 25 weeks, with a significant second-trimester correlation of r = 0.812. Although the individual weekly measurements varied slightly, both studies demonstrated consistent placental growth with advancing second-trimester gestational age.[8] During the third trimester, placental thickness based on fetal biometry increased from 29.30 ± 0.12 mm at 28 weeks to 34.40 ± 0.75 mm at 32 weeks, 37.16 ± 1.48 mm at 35 weeks, 38.46 ± 0.48 mm at 39 weeks and 39.69 ± 0.81 mm at 40 weeks. Agwuna et al. (2016) reported a mean third-trimester placental thickness of 36.1 ± 3.6 mm and a thickness of 42.0 ± 2.9 mm at 39 weeks. Their third-trimester correlation was r = 0.706, while placental thickness increased until 39 weeks and then decreased slightly at 40 weeks. In comparison, the present study recorded a lower thickness at 39 weeks but demonstrated a continued increase up to 40 weeks. These differences may be associated with population-related variation, distribution of gestational weeks and differences in the placental measurement technique. [9] Gestational age calculated from the last menstrual period also demonstrated a progressive increase in placental thickness. The mean thickness increased from 15.61 ± 0.49 mm at 15 weeks to 23.70 ± 0.65 mm at 20 weeks, 26.92 ± 0.87 mm at 25 weeks, 32.45 ± 1.29 mm at 30 weeks, 37.16 ± 1.48 mm at 35 weeks and 39.69 ± 0.81 mm at 40 weeks. Basnet et al. (2020) reported corresponding values of 14.95 ± 0.30 mm at 15 weeks, 20.25 ± 0.61 mm at 20 weeks, 25.00 mm at 25 weeks, 30.22 ± 0.40 mm at 30 weeks, 34.72 ± 1.02 mm at 35 weeks and 38.33 mm at 40 weeks. They observed that placental thickness almost corresponded to gestational age between 11 and 34 weeks but remained approximately 1–2 mm below gestational age from 35 to 40 weeks. The values in the present study were generally higher during late gestation, although both studies demonstrated the same progressive pattern.[10] Analysis according to gestational-age groups revealed a strong positive correlation between placental thickness and gestational age. The correlation coefficients were r = 0.980 at 15–20 weeks, r = 0.902 at 21–25 weeks, r = 0.803 at 26–30 weeks, r = 0.800 at 31–35 weeks and r = 0.820 at 36–40 weeks, with $p < 0.00001$ in every group. The overall correlation was r = 0.909, indicating that placental thickness increased strongly with gestational age throughout the study period. Banik et al. (2022), in 134 singleton pregnancies, reported an overall correlation of r = 0.966 and observed that placental thickness in millimetres approximately matched gestational age in weeks from 12 to 34 weeks. The slightly lower overall coefficient in the present study may be related to the larger sample and greater variability during late gestation.[11] When gestational age was estimated through fetal biometry, the present study found a strong correlation with placental thickness in the second trimester (r = 0.884, $p < 0.00001$) and an almost perfect correlation in the third trimester (r = 0.998, $p < 0.00001$). Naik et al. (2022) reported similarly strong correlations of r = 0.9943 during the second trimester and r = 0.9973 during the third

trimester. Their third-trimester result was almost identical to the present finding, although their second-trimester correlation was stronger. However, Naik et al. found that the relationship after 37 weeks was not statistically significant ($p = 0.469$), whereas the present study continued to demonstrate a significant relationship during late gestation. [12] According to the last menstrual period, the correlation between placental thickness and gestational age was $r = 0.754$ in the second trimester and $r = 0.995$ in the third trimester, with both relationships being statistically significant at $p < 0.00001$. Azagidi et al. (2020) studied 400 pregnant women and reported mean placental thicknesses of 24.6 ± 3.9 mm in the second trimester and 34.8 ± 2.8 mm in the third trimester. Placental thickness increased from 13.5 ± 1.9 mm at 11 weeks to 39.1 ± 0.6 mm at 40 weeks, and the strongest trimester-specific correlation was recorded in the second trimester at $r = 0.790$. Their second-trimester correlation was close to the present value of 0.754, whereas the present study demonstrated a substantially stronger third-trimester relationship. [13] Overall, the findings demonstrate that placental thickness increases progressively with gestational age and has strong correlations with gestational age estimated through both fetal biometry and the last menstrual period. The overall correlation of $r = 0.909$, together with the fetal-biometry correlations of $r = 0.884$ and $r = 0.998$ in the second and third trimesters, respectively, supports its value as an additional sonographic parameter. Sabeena et al. (2023) similarly observed an increase in placental thickness from approximately 10 mm at 11 weeks to 39.3 mm at 40 weeks and reported a strong overall correlation of $r = 0.977$ with gestational age, along with significant correlations with biparietal diameter, head circumference, abdominal circumference and femur length at $p < 0.001$. Thus, placental thickness may complement conventional fetal biometric measurements, particularly when the last menstrual period is uncertain or an individual biometric measurement is unreliable. [14].

CONCLUSION

Placental thickness showed a progressive increase with advancing gestational age from 15 to 40 weeks. A strong and statistically significant positive correlation was observed between placental thickness and gestational age estimated by both fetal biometry and the last menstrual period. The correlation was particularly strong during the third trimester. Therefore, ultrasonographic measurement of placental thickness may serve as a simple, reliable and useful supplementary parameter for estimating fetal gestational age.

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