e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 13(7); 297-303

Original Research Article

Correlation Between Gestational Age and Placental Thickness as Determined by Ultrasonography

Diddi Vamshi Kiran

Assistant Professor, Department of Radiology, Prathima Institute of Medical Sciences and Research, Naganoor, Karimnagar, Telangana

Received: 20-04-2023 / Revised: 21-05-2023 / Accepted: 28-07-2023
Corresponding author: Dr Diddi Vamshi Kiran
Conflict of interest: Nil

Abstract:

Background: Assessing placental thickness is a relatively straightforward and valuable clinical practice. Anomalies in placental thickness are widely acknowledged as early indicators in a range of pathological conditions. The measurement of placental thickness can play a pivotal role in the care and management of a potentially compromised fetus. The present study aimed to investigate the utilization of ultrasonography for measuring placental thickness during the third trimester of pregnancy and establishing a correlation between placental thickness and the gestational age of the fetus.

Methods: This was a cross-sectional study carried out in the Department of Radiology, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Sample Size: 100 antenatal women. Placental thickness was assessed at the point of umbilical cord insertion. The investigation focused on measuring placental thickness, and the mean thickness was then correlated with gestational age ranging from 28 weeks to 40 weeks.

Results: The findings revealed a gradual increase in placental thickness from 34.9mm at 28 weeks to 43.4mm at 40 weeks.

Conclusion: The study established a direct relationship between placental thickness and gestational age. Moreover, placental thickness also displayed a linear relationship with other parameters such as biparietal diameter (BPD), femur length (FL), and abdominal circumference (AC). As a result, placental thickness in millimeters could serve as a valuable supplementary parameter for estimating gestational age, particularly between the 28th and 40th weeks of pregnancy.

Keywords: Gestational age, Last menstrual period, Placental thickness, Ultrasonography.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

The application of sonography in assessing morphological aspects and identifying abnormalities within the placenta has gained substantial recognition within clinical contexts. Conditions such as nonimmune hydrops, gestational diabetes, chorioangioma, intraplacental hemorrhage, and intrauterine growth restriction have all been effectively evaluated through sonography.The placenta, being primarily a fetal organ, serves as a reflection of both fetal health and size. Placental size, an additional ultrasonographic parameter, is commonly employed for placental assessment. [1] Measuring placental thickness is a straightforward and clinically beneficial procedure. Anomalously thick placentas are widely acknowledged as indicative markers across a spectrum of pathological scenarios. This parameter holds the potential to aid in managing fetuses at risk. [2] Vital clinical decisions, including the need for a cesarean section or elective labor induction, rely on accurate knowledge of both gestational age and placental position.

The significance of placental thickness as a novel parameter for estimating gestational age, along with the establishment of nomograms for placental thickness in relation to gestational age, has been documented. Measuring placental thickness can effectively differentiate between normal and abnormal pregnancies. [3]

Ultrasound (USG) is conventionally utilized for estimating gestational age by assessing fetal dimensions like the Biparietal Diameter (BPD), Abdominal Circumference (AC), Head Circumference (HC), and Femur Length (FL). However, certain limitations exist in the accuracy of these parameters for estimating gestational age. This underscores the necessity for an additional parameter to enhance gestational age estimation with minimal error. Nyberg et al. [4] noted a correlation between placental thickness and gestational age. In our present research, we

endeavored to measure placental thickness at the umbilical cord insertion level and ascertain its relationship with the gestational age of fetuses in normal singleton pregnancies.

Material and Methods

This retrospective study was conducted in the Department of Radiology, Department of Radiology, Prathima Institute of Medical Sciences, Nagunoor, Karimnagar, Telangana State. Institutional Ethical approval was obtained for the study. This study was approved by the Institutional Review Board. Written consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language.

Inclusion Criteria

1. The normal singleton antenatal women 20 to 40weeks
2. History of regular menstruation
3. Known last menstrual period
4. Available for follow-up.

Exclusion Criteria

1. Maternal Diseases such as hypertensive disorders, Diabetes mellitus, Anaemia
2. Intrauterine growth restriction, Multiple pregnancies, Fetal anomalies
3. Irregular menstruation, Last menstruation period not known
4. Placenta previa, Placental abnormalities like bilobate placenta, succenturiate lobe,
5. placenta membraneca, Abnormal insertion of the umbilical cord-like velamentous placenta, and battledore placenta
6. Poor visualization of the placenta

Ultrasound Equipment and Transducer

The Sonoscape SSI5000 ultrasound system was utilized for performing ultrasonographic examinations. An ultrasound transducer operating at a frequency of 3.5MHz was employed for the examinations.

Ultrasound Measurement of Placental Thickness

During the ultrasonographic assessment, the patient was positioned in a supine posture with a moderately filled bladder. A layer of ultrasonographic gel was applied to the probe, which was then positioned on the patient's abdominal area. To begin with, the first amniotic fluid index was measured to exclude the presence of conditions like oligohydramnios and polyhydramnios. Following this, the measurement of placental thickness was carried out after measurements of the biparietal diameter, femur length, and abdominal circumference. Placental thickness was measured at the location where the umbilical cord is attached, and the measurement was recorded in millimeters. The determination of the placental thickness required accurate identification of the umbilical cord insertion site. Generally, this insertion site is situated centrally within the placenta. The measurement itself involved calculating the distance from the echogenic chorionic plate to the interface between the placental myometrium and the chorion. It was essential to perform this measurement when the uterus was in a relaxed state, and not during instances of uterine contractions. Various factors, including maternal blood volume, placental tissue composition, and fetal blood volume, influenced the placental thickness. Precise identification of both edges of the placenta within the sonographic field was of utmost importance. Once the cord insertion site was pinpointed, a direct line was drawn from this site to the maternal surface of the placenta. The measurement of placental thickness was taken perpendicular to the uterine wall. For each gestational age between 28 and 40 weeks, the mean placental thickness values and their corresponding standard deviations were calculated. Correlation analysis was conducted to evaluate the association between placental thickness (measured in millimeters) and gestational age (expressed in weeks).

Statistical Analysis: All the available data was uploaded to an MS Excel spreadsheet and analyzed by SPSS version 21 in Windows format. The continuous variables were represented as mean, standard deviations, percentages, and correlation coefficient r values and were analyzed by using Pearson's coefficient correlation analysis.

Results

A total of 100 cases were included in the study. The age group distribution of cases is depicted in Figure 1. The most common age group was 21 – 25 years with 47% of all cases. Followed by the age group of 26 – 30 years with 42% of all cases. The minimum age of the case was 19 years and maximum age was 37 years and the mean age of the cohort was 26.85 ± 3.5 years.

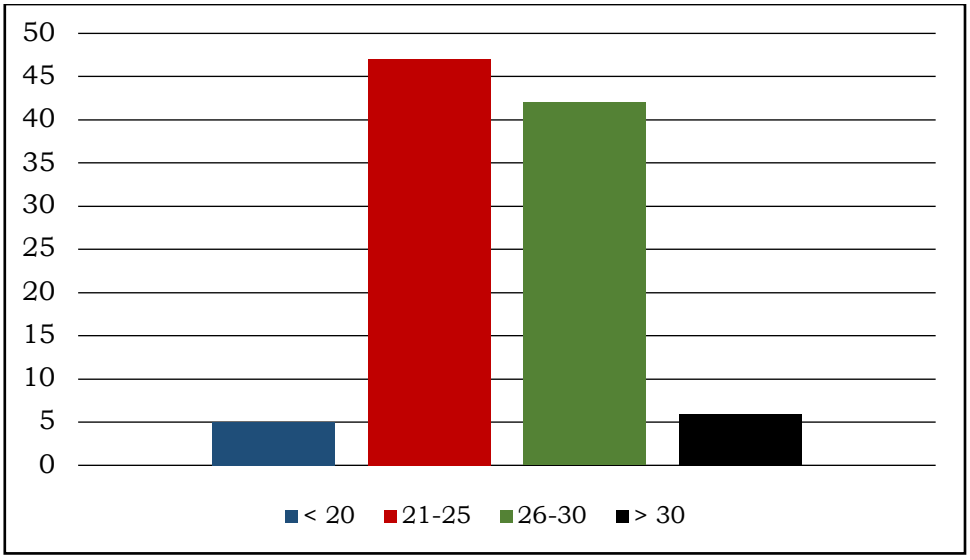

Figure 1: Age group-wise distribution of cases included in the study

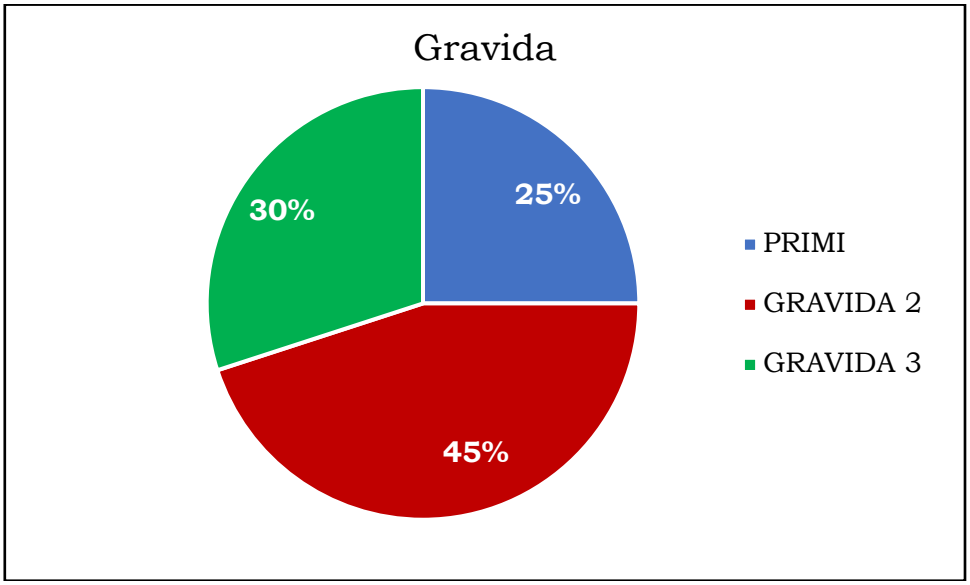

Figure 2: Parity distribution among the cases of the study

In this study based on the gravida we had primi in 25% of cases Gravida 2 in 45% of cases and gravida 3 in 30% of cases (figure 2)

Table 1: Showing the gestation age and mean values in the cases of the study

Gestational Age	Frequency	Mean	SD	95% CI
28 weeks	1	30.4	0.00	30.40
29 weeks	2	30.7	0.41	27.55 – 30.95
30 weeks	7	31.52	1.47	29.12 - 32.45
31 weeks	4	32.19	0.49	30.58-33.09
32 weeks	12	33.02	1.31	31.66 – 34.58
33 weeks	10	33.75	1.06	32.16-34.48
34 weeks	15	34.35	0.82	33.56-35.44
35 weeks	11	34.73	1.07	33.02-35.98
36 weeks	14	35.16	0.86	33.07-36.26
37 weeks	11	35.9	1.33	34.71-36.49
38 weeks	6	37.0	1.61	35.80-38.92
39 weeks	6	38.33	1.75	36.80-38.87
40 weeks	1	38.91	0.00	38.91

Table 1 displays the average placental thickness along with its corresponding standard deviation based on gestational age. The information presented in the table indicates that as the gestational age progresses from 28 weeks to 40 weeks, there is a corresponding increase in placental thickness from 30.4mm to 38.91mm. A critical analysis of this table, it becomes evident that there exists a linear correlation connecting gestational age with placental thickness (Figure 1).

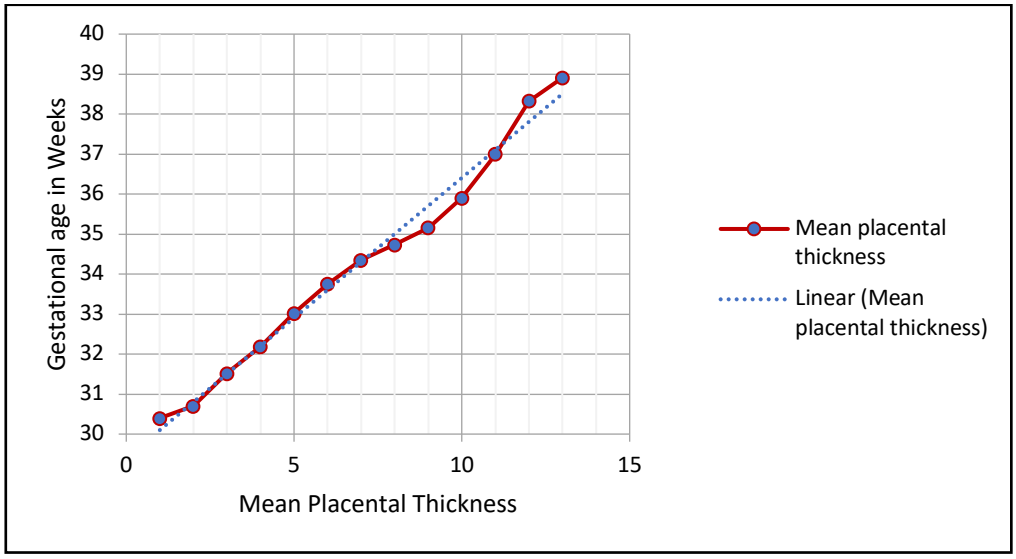

Figure 1: Showing the mean placental thickness at different gestational ages

Figure 2 presents a comparison between Placental Thickness and Biparietal Diameter measurements. The data includes various values for both parameters. Notably, Placental Thickness ranges from 30.4 to 38.91mm, while Biparietal Diameter spans from 79.55 to 95.57mm. These measurements are likely taken at different stages or conditions, reflecting potential correlations or patterns between Placental Thickness and Biparietal Diameter. Further analysis of the data reveal relationships between these two variables which were to be linear.

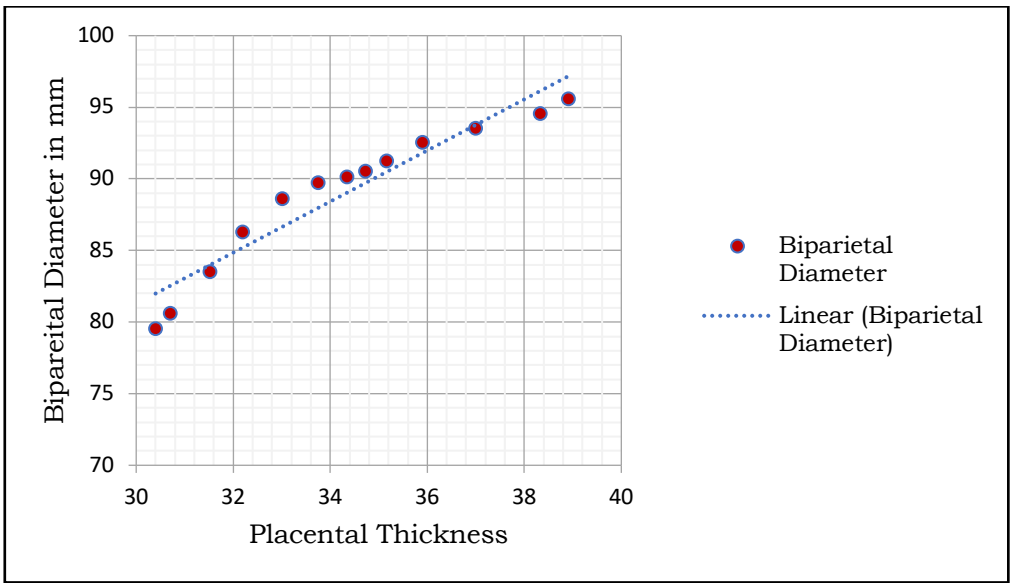

Figure 2: Showing the mean placental thickness versus Biparietal diameter in mm in the cases of the study

Figure 3 showcases the relationship between Placental Thickness and Mean Femur Length measurements. Each row in the table represents a specific value of Placental Thickness along with its corresponding Mean Femur Length. As Placental Thickness increases from 30.4 to 38.91 mm, there is a corresponding trend of Mean Femur Length increasing from 54.25 to 89.05 mm. This suggests a potential positive correlation between Placental Thickness and Mean Femur Length – as the placenta becomes thicker, the mean length of the femur tends to

increase. The data points illustrate a pattern where both Placental Thickness and Mean Femur Length progressively rise.

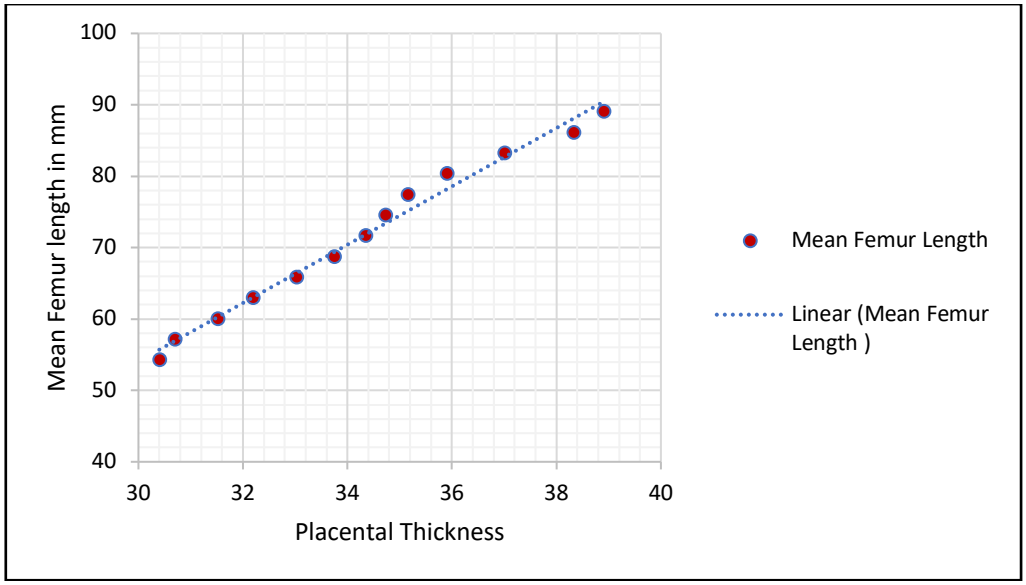

Figure 3: Showing the mean placental thickness versus Femur length in mm in the cases of the study

The presented Figure 4 illustrates the correlation between Placental Thickness and Abdominal Circumference measurements. As Placental Thickness increases gradually from 30.4 to 38.91, there appears to be a concurrent trend of Abdominal Circumference expanding from 239 to 360.3 mm. This pattern implies a possible positive correlation between Placental Thickness and Abdominal Circumference – as the placenta thickens, the abdominal circumference tends to increase.The data points collectively display a consistent rise in both Placental Thickness and Abdominal Circumference measurements. This relationship could point towards an intricate interplay between fetal growth and placental development, resulting in the synchronized growth of the abdominal region and the placenta.

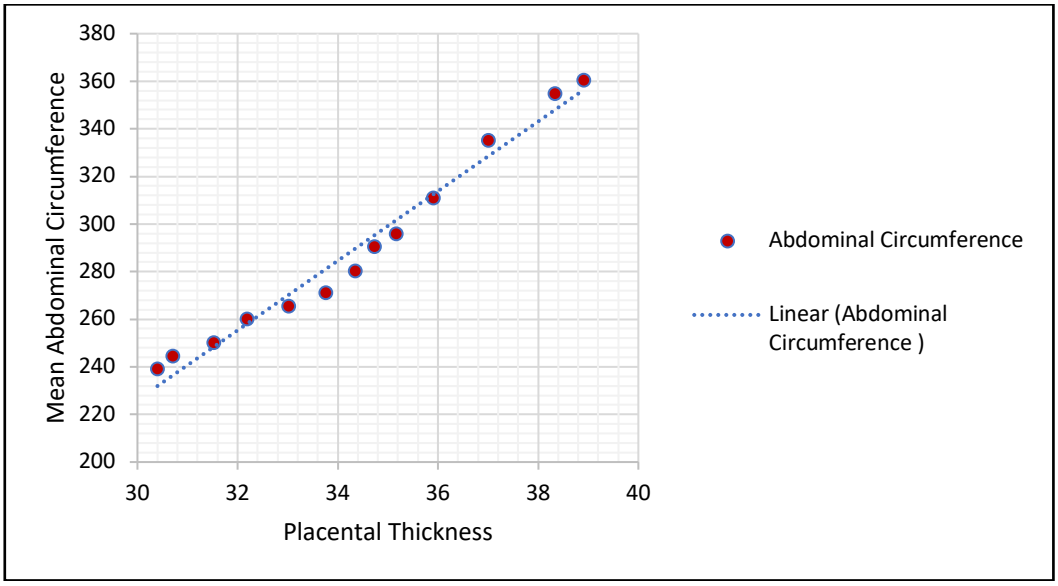

Figure 4: Showing the mean placental thickness versus Abdominal circumference in mm in the cases of the study

Table 2: **BPD, FL, AC, and GA showing positive correlation with placental thickness**

Variables	Frequency	R^2	P value
PT versus BPD	100	0.995	< 0.0001
PT versus AC	100	0.854	< 0.0001
PR versus FL	100	0.714	< 0.0001
PT versus GA	100	0.816	< 0.0001

The associations between BPD, AC, femur length, and gestational age with placental thickness were investigated. The Pearson correlation coefficients between placental thickness and BPD, AC, femur length, and gestational age were found to be 0.995, 0.854, 0.714, and 0.816, respectively. These correlation coefficients were highly significant from a statistical standpoint ($p<0.001$). Placental thickness played a substantial role in explaining the variance in these variables. Specifically, the determination coefficients (r) indicated that BPD was influenced by placental thickness by approximately 94.73%. Similarly, AC, femur length, and gestational age were determined to a significant extent by placental thickness, with proportions of 95.46%, 95.14%, and 96.81%, respectively.

Discussion

Obstetric ultrasound examinations primarily focused on assessing the location and position of the placenta. However, with the advent of advanced ultrasonography techniques, it has become possible to identify morphological changes in the placenta as it matures. As the pregnancy progresses, the placental thickness experiences a gradual increase. Therefore, it is crucial to evaluate unusually thick or thin placentas and establish correlations with other parameters to estimate the duration of the pregnancy accurately. [5] The practice of measuring placental thickness through ultrasound has been introduced earlier. By establishing normal placental thickness measurements for each week of gestational age, we can effectively discern whether the placental thickness falls within the expected ranges or deviates from the norm. [6] This study delves into the measurement of placental thickness and explores its correlation with gestational age. The findings of this study demonstrate a consistent and gradual rise in placental thickness as gestational age advances from 28 to 40 weeks.

Hoddick et al. [7]found that the average placental thickness (measured in mm) aligns closely with gestational age (measured in weeks). Mital P et al. [8] observed a consistent upward trend in mean placental thickness (measured in mm) with increasing gestational age (measured in weeks). They noted that placental thickness (measured in mm) almost precisely mirrored gestational age in weeks. Jain A et al. [9] also noted similar correlations between placental thickness and gestational age. Their findings indicated that placental thickness (measured in mm) closely corresponded to gestational age (measured in weeks) from the 27th to the 33rd week of gestation. Grannum et al. [10] reported that placental thickness exhibited a linear increase until the 33rd week of pregnancy, after which a gradual thinning occurred. Other researchers reported similar outcomes. They found a gradual decline in placental size after the 32nd week until full term. [10]Hadlock et al. [11] cautioned against overemphasizing any single measurement when estimating age, suggesting that the most accurate estimate could vary between cases.

The current study investigated the connection between placental thickness (measured in mm) and sonographic gestational age (measured in weeks), as well as the growth pattern in relation to advancing gestational age. The study revealed a consistent linear increase in placental thickness (measured in mm) with the progression of gestational age (measured in weeks) from weeks 28 to 40. However, the rate of placental thickness increase gradually diminished from weeks 36 to 40, with a difference of 1-4 mm compared to gestational age (measured in weeks).The significance of placental size lies in its ability to reflect the normal growth of the fetoplacental unit, which can be measured using ultrasonography (USG) and is valuable for describing normal physiological processes. A thin placenta often indicates small for gestational age fetuses and growth restriction. Placental thinning is also observed in cases of preeclampsia, chromosomal abnormalities, and severe intrauterine infection. Conversely, thick placentas are associated with hydrops fetalis, diabetes mellitus, and intrauterine infections. The thick placenta is also linked to increased perinatal risk and higher mortality rates related to fetal anomalies, as well as elevated rates of both small for gestational age and large for gestational age infants at term.

Conclusion

Placental thickness increases with gestational age, especially during the third trimester. There is a linear relationship between placental thickness and gestational age, as well as between placental thickness and other fetal parameters. This suggests that placental thickness can be used as an additional parameter to estimate gestational age, along with BPD, femur length, and abdominal circumference. Abnormal placental thickness can be an indicator of fetal abnormalities and maternal diseases. The thickness of the placenta increases as the pregnancy progresses. This increase is most noticeable during

the third trimester. There is a direct relationship between placental thickness and gestational age, meaning that the thicker the placenta, the more advanced the pregnancy. There is also a direct relationship between placental thickness and other fetal parameters, such as the size of the head, the length of the thigh bone, and the circumference of the abdomen. This suggests that placental thickness can be used to estimate gestational age, along with these other parameters. If the placental thickness is abnormal for a given gestational age, it could be a sign of a fetal abnormality or a maternal disease.

References

1. Tongsong T, Boonyanurak P. Placental thickness in the first half of pregnancy. J Clin Ultrasound. 2004 Jun;32(5):231-4.
2. Jauniaux E. Placental ultrasonographic measurement: what can we learn and is it worth doing routinely? Ultrasound Obstet Gynecol. 1992 Jul 1;2(4):241-2.
3. Ghosh A, Tang MH, Lam YH, Fung E, Chan V. Ultrasound measurement of placental thickness to detect pregnancies affected by homozygous alpha-thalassemia-1. Lancet. 1994 Oct 8;344(8928):988-89.
4. Nyberg DA, Finberg HJ. The placenta, placental membranes, and umbilical cord. Journal on diagnostic ultrasound of fetal anomalies. 1990;21(4):623–75.
5. Karthikeyan T, Subramaniam RK, Johnson W, Prabhu K. Placental thickness & its correlation to gestational age & fetal growth parameters- a cross-sectional ultrasonographic study. J Clin Diagn Res. 2012 Dec;6(10):1732-5.
6. Banik S, Rajkumari A, Devi AJ, Sarkar R, Ayekpam M. Placental Thickness Measurement by Ultrasonography and Its Correlation with Gestational Age of Fetus in the Manipuri Population. Int J Appl Basic Med Res. 2022 Apr-Jun;12(2):117-122.
7. Hoddick WK, Mahony BS, Callen PW, Filly RA. Placental thickness. J Ultrasound Med. 1985 Sep;4(9):479-82.
8. Mital P, Hooja N, Mehndiratta K. Placental thickness: A sonographic parameter for estimating the gestational age of the fetus. Indian J Radiol Imaging. 2002; 12:553–54.
9. Anupama Jain, Ganesh Kumar, Agarwal U, Kharakwal S. Placental thickness- a sonographic indicator of the gestational age. Jou of Obst and Gyne of India. 2001; 51(3):48–49.
10. Grannum PA, Hobbins JC. The placenta. Radiol Clin North Am. 1982 Jun;20(2):353-65.
11. Hadlock FP, Harrist RB, Martinez-Poyer J. How accurate is second-trimester fetal dating? J Ultrasound Med. 1991 Oct;10(10):557-61.