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Original Research Article

Ultrasonographic Assessment of Placental Thickness and Its Correlation with Neonatal Birth Weight

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Abstract:
Background: Placental insufficiency significantly impacts fetal development, yet the antenatal diagnosis of fetal growth restriction (FGR) is only about 30% accurate. Traditional assessments focus on the placenta's position, maturity, and morphology. This study zeroes in on placental thickness, investigating its potential as an indicator of FGR and its correlation with neonatal birth weight.
Materials and Methods: Conducted at a tertiary medical institute's Department of Radiodiagnosis, this prospective observational study involved 100 third-trimester pregnant women referred for prenatal ultrasonography. It aimed to explore the relationship between placental thickness measured via ultrasound and fetal well-being, correlating these findings with ultrasonographic outcomes post-delivery.
Results: The findings revealed a modest correlation (0.459, $p < 0.01$) between reduced placental thickness and lower birth weights in pregnancies beyond 32 weeks of gestation. All participants in this gestational age group with diminished placental thickness had newborns weighing below the 10th percentile. No notable correlation was found in pregnancies under 32 weeks. In cases of FGR, 8 out of 18 fetuses had thin placentas. Additionally, over 70% of infants with either significantly large or thin placentas exhibited poor Apgar scores, suggesting a link between placental thickness and neonatal health.
Conclusion: Measuring placental thickness offers a practical addition to fetal biometry and Doppler studies for screening FGR. This method could improve the early detection and intervention strategies for pregnancies at risk, potentially enhancing outcomes for affected neonates.
Keywords: Intrauterine growth restriction, Small for gestational age, Placental thickness, Birth weight, APGAR scores

Introduction

The intricate interplay between placental health and neonatal outcomes forms a fundamental aspect of obstetric research and clinical practice, with placental thickness measured via ultrasonography standing out as a key predictor of fetal well-being and neonatal birth weight. The study aims to delve into how advancements in ultrasound technology have facilitated detailed assessments of placental morphology, and how these assessments correlate with crucial neonatal outcomes, particularly birth weight [1]. The placenta's critical role in fetal development, acting as the exchange interface for nutrients and gases between mother and fetus, underscores the importance of its health and morphology in determining fetal growth and development outcomes. Ultrasonography, as a non-invasive imaging technique, has become indispensable in obstetrics for monitoring these developments throughout pregnancy, with placental thickness being a parameter of particular interest due to its association with fetal outcomes like birth weight, a vital determinant of neonatal health and survival [2].

This discussion extends into the methodology of measuring placental thickness using ultrasound, establishing normative values through clinical research, and identifying factors that may influence these measurements. It further examines the evidence linking placental thickness to neonatal birth weight, highlighting how deviations from normal values can signal potential risks to fetal health, such as intrauterine growth restriction (IUGR) or macrosomia. The clinical implications of these findings are significant, informing prenatal care strategies aimed at improving neonatal outcomes. Moreover, the introduction emphasizes the importance of ultrasonographic placental assessment as a predictive tool in obstetrics, enhancing prenatal care and fetal health monitoring, and contributing to a broader understanding of fetal development and the early identification of at-risk pregnancies [3].

Intrauterine growth limitation, especially prevalent in developing countries, is a significant concern, with placental insufficiency being a primary cause of restricted fetal development. The severity of newborn morbidities associated with IUGR or Fetal Growth Restriction (FGR) is influenced by the timing and extent of placental dysfunction and the infant's gestational age at birth. The distinction between Small for Gestational Age (SGA) and IUGR is crucial, with SGA defined as neonates born with a birth weight below the 10th percentile for their gestational age, focusing solely on birth weight without considering in-utero growth or physical condition [4]. Conversely, IUGR is identified in newborns exhibiting signs of malnutrition and growth retardation in-utero, regardless of their birth weight percentile. Amidst efforts to improve IUGR identification, there's a pressing demand for further research on placental assessment, including its dimensions, shape, and weight. Placental thickness, as a practical metric for evaluating placental size, has shown a direct correlation with gestational age and a reduction in infants with low birth weight, underscoring the need for more research on its linkage to neonatal birth weight and its predictive value for IUGR within studied birth cohorts [5].

Materials and Methods

The study, conducted at the Department of Radio Diagnosis in a tertiary medical college, was a prospective observational endeavor that adhered strictly to ethical guidelines and received the necessary approval from the institute's ethics and research committee. Spanning from January 2019 to June 2020, it involved 100 antenatal women in their third trimester who were referred for ultrasonographic assessment. The focus was on those carrying a singleton pregnancy within the third trimester, specifically targeting cases clinically suspected of Intrauterine Growth Restriction (IUGR). Exclusion criteria were set to omit women with systemic illnesses like Diabetes Mellitus and severe anemia, those with multiple pregnancies, and cases where placental abnormalities or poor visualization of the placenta were factors.

Upon selection, participants underwent a detailed recording of their medical history, including age, gestational age, and any relevant family history. This was followed by comprehensive counseling to ensure they were fully informed about the study's objectives and the significance of their participation. Informed written consent was obtained to guarantee their confidentiality and privacy. The study meticulously prepared for the commencement of the obstetric scans, ensuring all preliminary formalities were in place.

The ultrasonography procedure involved measuring the placental thickness from the echogenic chorionic plate to the placental myometrial interface in centimeters. Care was taken to ensure measurements were made when the uterus was relaxed, not during contractions, with a direct line drawn from the cord insertion site to the maternal surface of the placenta for accurate assessment. These measurements were then documented for future reference.

For statistical analysis, the study employed means (+ Standard Deviation), frequencies (number of cases), and percentages to present the categorical data. An unpaired T-test was utilized to compare the means of two distinct gestational age groups, those less than 32 weeks and those 32 weeks or more. SPSS version 21.0 was the tool of choice for conducting these analyses, aiding in the thorough examination of the collected data.

To ensure the integrity of the study and minimize bias, a blinded analysis approach was adopted. Sonographers tasked with measuring placental thickness were kept unaware of the participants' clinical details and outcomes, aiming to eliminate subjective bias in the measurements and interpretations, thus bolstering the study's reliability and validity.

Results

The study, involving 100 antenatal women in their third trimester, shed light on the relationship between placental thickness and neonatal birth weight, among other fetal outcomes. Participants were categorized based on their gestational age into two groups: 79 subjects were over 32 weeks, and 21 were under 32 weeks of gestation. The average participant age was 26.7 years, predominantly in their third decade, with no significant link between maternal age and placental thickness. The cohort mainly consisted of third-time mothers (39%), with the majority of placentas being grade II (89%) and most commonly located anteriorly (50%).

The study found that placental thickness, as measured by trans-abdominal ultrasonography, averaged 3.42 cm. It highlighted a critical observation that all subjects with placentae thinner than the 10th percentile gave birth to small-for-gestational-age (SGA) neonates, despite the absence of prenatal indications of thin placentae in women who delivered SGA neonates. The average birth weight was 2.582 kg, with a clear difference observed between scans conducted before and after 32 weeks of gestation. Notably, 18% of the infants were classified as SGA, being born below the 10th percentile for birth weight.

A pivotal discovery of this research was the mild positive correlation between placental thickness and birth weight in pregnancies beyond 32 weeks, with a correlation coefficient of 0.459 and a significance level of $p < 0.01$. This correlation did not extend to pregnancies under 32 weeks. Additionally, the study found a positive association between Apgar scores and placental thickness, suggesting that placental thickness might influence fetal outcomes. Specifically, neonates with placental thickness below the 10th percentile often had lower Apgar scores, while those with thickness above the 95th percentile also faced adverse outcomes. These findings underscore the potential of placental thickness as a predictive marker for assessing neonatal health.

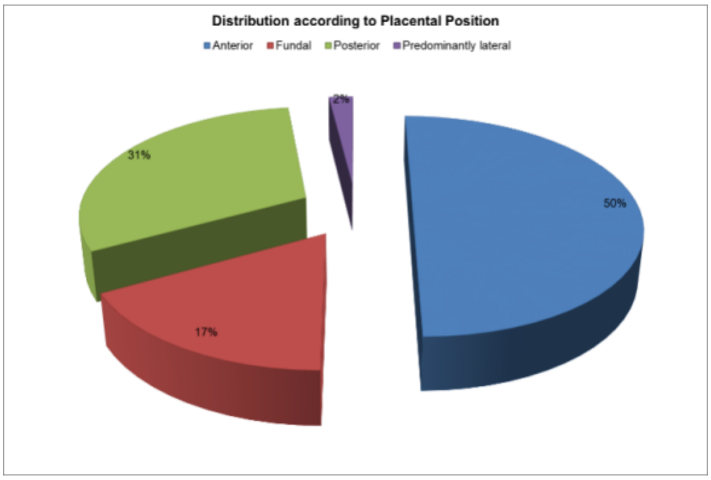

Figure 1: **Pie chart representing distribution of study population according to placental position.**

Table 1: Placental thickness (cm) percentiles in our study.

Percentile	Thickness(cm)
10^{th} percentile	2.310
25^{th} percentile	2.885
50^{th} percentile	3.300
75^{th} percentile	4.100
95^{th} percentile	4.51
Mean	3.426

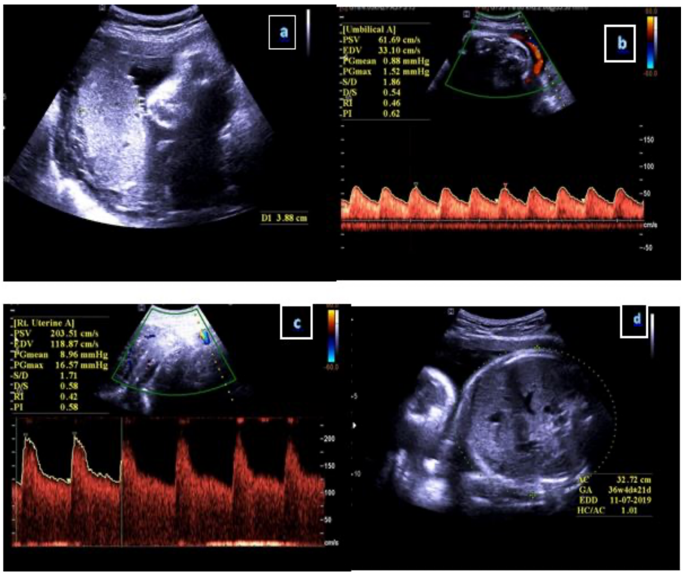

Figure 2: USG images of a 26 year old antenatal woman with term delivery of AGA neonate. A. USG image showing normal placental thickness. B. Spectral Doppler image showing normal flow in umbilical artery. C. Spectral Doppler image showing normal low resistance flow in in right uterine artery. D. USG image showing abdominal circumference (normal).

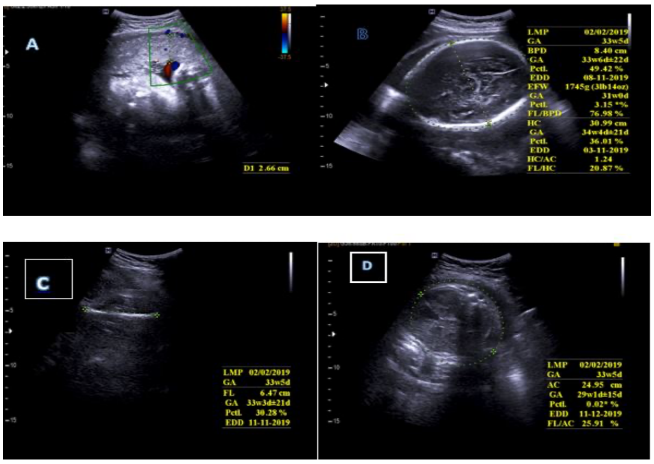

Figure 3: USG images of a 24 year old antenatal woman with preterm delivery of SGA neonate. A. USG image showing measured placental thickness (> 10th percentile). B.USG image showing measured BPD and HC (within normal limits). C. USG image showing measured femoral length (within normal limits). D. USG image showing AC measurement (less than 10th percentile)

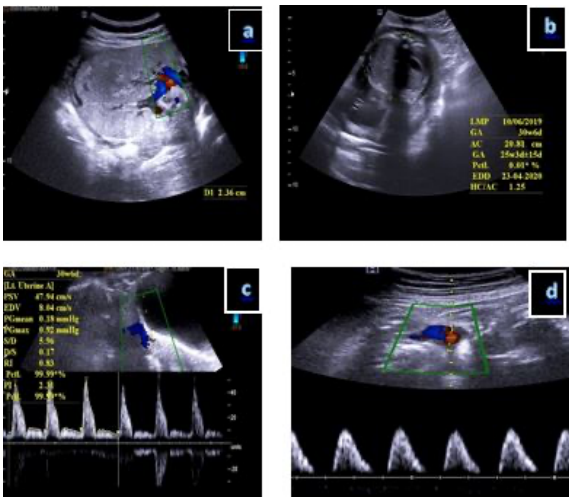

Figure 4: USG images of a 27 year old antenatal woman with uteroplacental vascular insufficiency in Doppler and preterm delivery of SGA neonate.
A: USG image showing measured placental thickness (>10th percentile) B: USG image showing abdominal circumference (<10th percentile). C: Spectral Doppler image of left uterine artery showing diastolic notch. D: Spectral doppler image of umbilical artery showing absent diastolic flow.

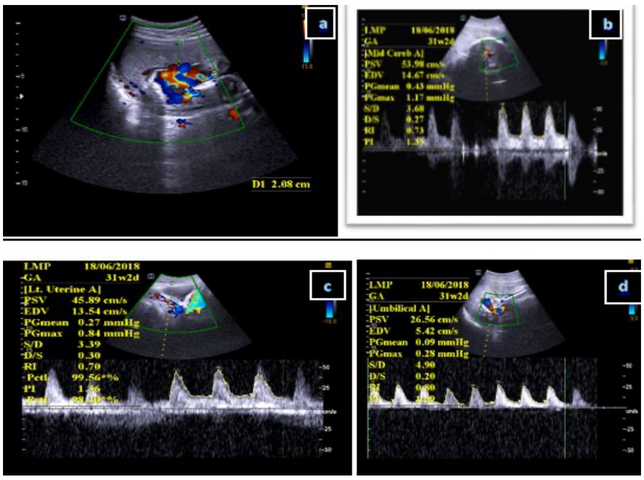

Figure 5: USG images of a 34 year old antenatal woman with abnormal Doppler study, delivered preterm SGA newborn.

A: USG image showing measured placental thickness (<10th percentile) B: Spectral Doppler image of MCA with abnormal low resistance spectral pattern. C: Spectral Doppler image of left uterine artery showing abnormal high resistance spectral pattern. D: Spectral Doppler image of umbilical artery showing abnormal high resistance spectral pattern.

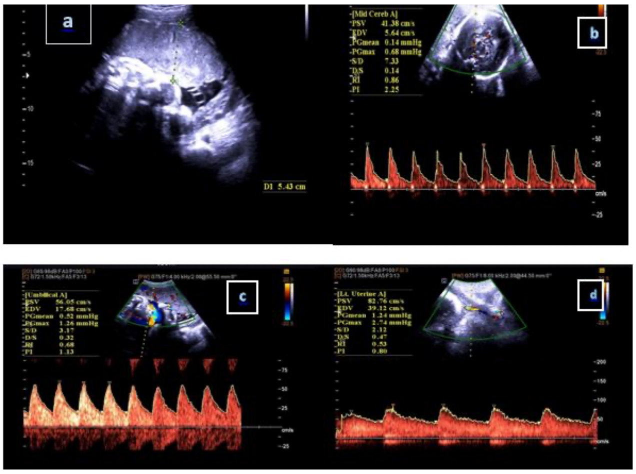

Figure 6: USG images of a 28 year old antenatal woman with normal Doppler study. A: USG image showing measured Placental thickness (> 95th percentile). B: Spectral Doppler pattern of MCA was normal. C: Spectral Doppler image showing normal spectral pattern in umbilical artery. D: Spectral Doppler image showing normal spectral pattern in left uterine artery.

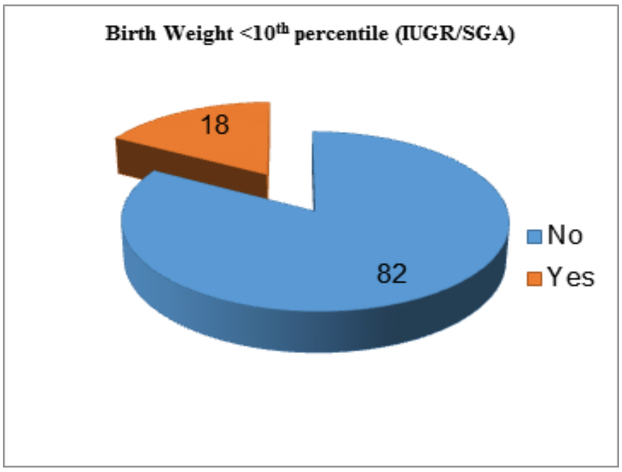

Figure 7: Pie chart showing distribution of Birth weight <10th percentile and >10th percentile.

Table 2: Depicts correlation of placental thickness with birth weight in both study groups. There was low positive correlation in > 32 weeks GA group. In < 32 weeks GA group there was no statistically significant correlation.

Gestational age (week)			Birth Weight (kg)
< 32	Placenta Thickness (cm)	Pearson Correlation	0.209
		p-value	0.363
>32	Placenta Thickness (cm)	Pearson Correlation	0.459**
		p-value	0.001

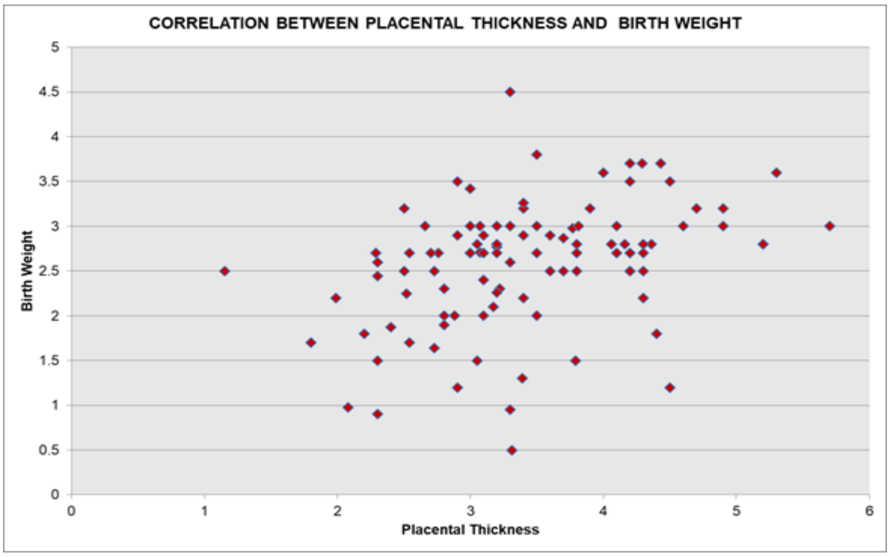

Figure 8 (a): (scatter diagram) shows that the data (represented by dots) shows mild uphill pattern as we move from left to right thus indicating a low positive correlation.

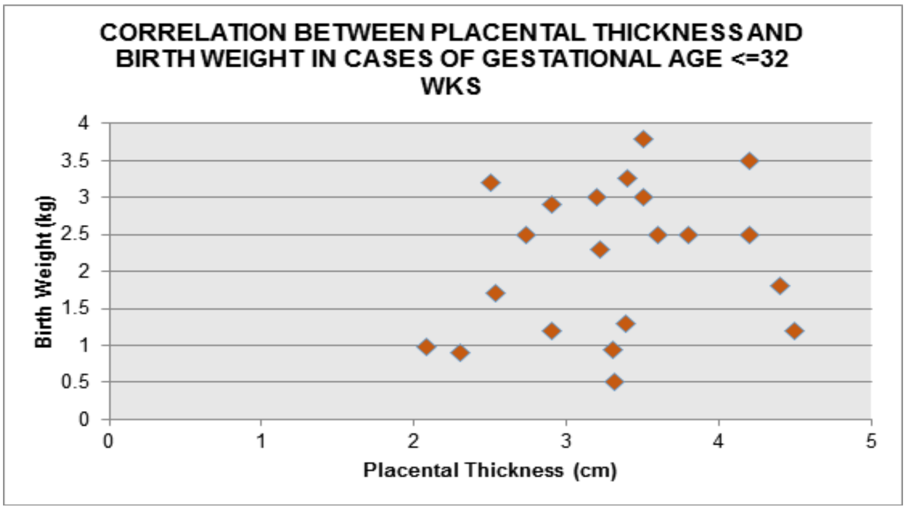

Figure 8(b): (scatter plot) shows that there is no uphill pattern. As the values on x axis increase there is no significant increase in values on y axis indicating no significant correlation between two variables.

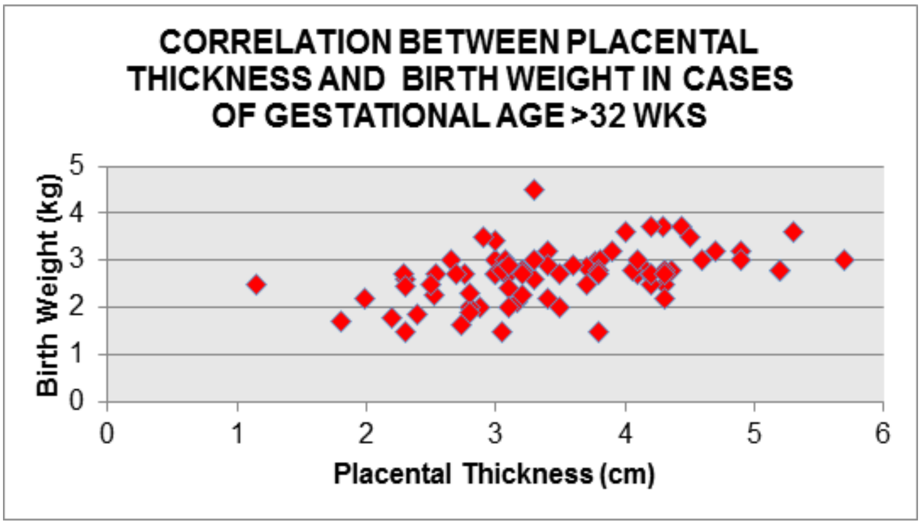

Figure 9: (scatter diagram) depicts correlation of birth weight with placental thickness in >32 weeks gestational age group. The data (represented by dots) shows mild uphill pattern as we move from left to right thus indicating a low positive correlation.

Discussion

The study's findings underscore the pivotal role of placental size and structure in diagnosing fetal growth restrictions, highlighting that the actual size of the fetus mirrors the past performance of the placenta until real-time assessments, such as Doppler measurements of blood vessel flow, become possible. Parameters like thickness, surface area, and volume of the placenta are invaluable for diagnosing fetal growth restriction, with placental efficiency being a critical determinant of optimal fetal growth and development within the uterus. The correlation identified between placental thickness and birth weight suggests that placental thickness tends to increase alongside fetal weight and gestational age, revealing that conventional prenatal ultrasound may not always detect fetal growth limitations, as approximately 75% of newborns classified as small-for-gestation are diagnosed based on post-birth weight measurements [6,7].

The demographic analysis of the study participants showed no significant correlation between the age of women and placental thickness, aligning with findings from previous research. The parity distribution indicated that most women were multipara, with a significant portion being primigravidae. The study also highlighted the importance of placenta localization in ultrasound examinations, noting that anterior placentae are easier to examine due to their proximity to the ultrasonography probe. The majority of placentae were found to be anterior and thinner than those in other locations, supporting findings from earlier studies [8-19].

Placental thickness measurements revealed an average of 3.426 cm in the third trimester, with a slight positive relationship between birth weight and placental thickness observed in pregnancies over 32 weeks of gestational age. This relationship underscores the dependence of the fetus on the placenta for essential nutrients and oxygen, suggesting that any damage to the placenta can adversely affect fetal development. The study, however, found a less strong positive linear correlation between placental thickness and birth weight compared to some previous research, indicating the need for further investigation into this relationship [20-25].

Interestingly, the study found that 8 out of 18 fetuses diagnosed with intrauterine growth restriction (IUGR) exhibited placental thickness below the 10th percentile, suggesting a significant association between thin placentae and fetal development problems. This finding aligns with other research indicating that placental thickness measured in the second trimester can be an important predictor of birth weight and that conditions like preeclampsia or infections could affect the study results, potentially obscuring the true relationship between placental thickness and fetal growth restriction [26-28].

The research concluded with a weak positive relationship between birth weight and placental thickness during the late third trimester, suggesting that late-onset fetal growth restriction may have a distinct pathophysiological pathway with milder hemodynamic changes. This could explain why late-onset fetal growth restriction often goes undetected on ultrasound/Doppler, highlighting the need for further research in this area. Additionally, the study observed a weak positive relationship between APGAR scores and placental thickness, indicating that infants with intrauterine growth restriction often exhibit poor tolerance to childbirth, which can lead to low APGAR scores and immediate health issues post-delivery [29-31].

Conclusion

One of the main reasons for fetal insufficiency is placental. Ultrasound placental thickness measurement, along with fetal biometry and Doppler, can help us anticipate SGA/IUGR newborns. Thin and thick placentas correlate with poor infant outcomes. Placental thickness measurement may help peripheral health institutions in India without Doppler facilities refer high-risk pregnancies.

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