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Ultrasound Assessment of Placental Thickness in The Last Two Trimesters of Normal Pregnancy and Its Relations with Fetal Outcome

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ABSTRACT

Background: Ultrasound measurements of placental thickness have been a straightforward, repeatable, and clinically beneficial method for over two decades. The placenta grows faster than the fetus in the 1st trimester.

Objective: To assess the correlation among fetal birth and placental weight, and placenta thickness through the 2nd and 3rd trimesters.

Patients and Methods: 112 pregnant women who visited the outpatient clinic were part of the current cohort observational study conducted at Damanhur Medical National Institute from September 2023 until February 2024. The concerned cases were separated into three sub-groups according to the thoroughness of the placenta.

Results: Only 10.7% of the newborns of patients in the second trimester with normal placental thickness were admissible to the neonatal intensive care unit (NICU) after birth, compared to 58.3% of cases in the thin placenta group and 81.25% in the thick placenta group. Only 11.6% of the newborn of third-trimester cases with normal placental thickness were admitted to the NICU, in contrast to 40% of cases for thin placentas and 56.3% of cases for thick placentas. The placenta's thickness in the 2nd trimester was significantly positively associated ($p < 0.05$) with the placental weight, Apgar score, and fetal birth weight.

Conclusions: We concluded that measurement of placental characteristics should be a part of all standard prenatal ultrasounds since placenta thickness can be used in conjunction with other biometric markers to predict neonatal outcomes.

Keywords: Placental thickness, Pregnancy, Fetal outcome, Ultrasonography.

INTRODUCTION

The assessment of the placenta has become a vital element of the fetal anatomy survey, as it is regarded as a fetal organ. Historically, the placental pathologist was only able to investigate placental morphology post-partum [(1)].

Currently, sonography allows for the placental assessment and identification of placental abnormalities that may have a significant impact on the management and result of the pregnancy [(2)]. The placenta grows faster than the fetus in the first trimester. However, placental and fetal weights are roughly similar by 17 weeks [(3)]. At term, the placenta has a discoid form, is 15 to 25 centimeters in diameter, is three cm thick, and weighs between 500 and 600 g [(4)].

The diagnosis of certain abnormalities might be facilitated by the determination of the placental thickness. For example, fetal growth restriction can be defined by a thin placenta, while hydrops fetalis is caused by hemoglobin Bart's disease and is characterized by placental thickening [(5)]. Nevertheless, abnormal placental thickness values can't be evaluated until the normal values have been determined [(6)].

When the gestational sac is 10 weeks old, the definitive placenta may be observed on transabdominal ultrasonography as a uniformly granular echogenic ring. Utilizing several criteria (for example placental thickness and volume), otherwise specialized methods as three-dimensional power Doppler and ultrasonography (US) are utilized to evaluate the placenta and identify any abnormalities in the placenta [(7)]. Ultrasound measurements of placental thickness have been a straightforward, repeatable, and clinically beneficial method for over two decades[(8)] .

The thickness of the placenta should reflect the nutritional status of the fetus and the fetal result [(9)].

Thickness of the placenta is the easiest method of determining the size of the placenta. It is at its greatest at the center and at its lowest at the periphery. The placental thickness evaluation is typically conducted perpendicularly at the umbilical cord level, as recorded by numerous observers [(10)].

The fetus's condition can be reflected in the placenta, and an abnormal placental size can detect any anomalies in the third trimester. A thin placenta that measures less than 2.5 cm in thickness is a sign of growth restriction [(3)].

Our study aimed to assess the correlation among placental weight, placental thickness, and fetal weight through the 2nd and 3rd trimesters.

PATIENTS and METHODS

112 pregnant females that visited the outpatient clinic were part of the current cohort observational study conducted at Damanhur Medical National Institute from September 2023 until February 2024.

The concerned cases were separated into three sub-groups according to the thoroughness of the placenta: Normal placental thickness is among the 10th and 90th percentiles (N = 84 in the 2nd trimester and N = 86 in the 3rd trimester). Placental thickness less than the 10th percentile indicates a thin placenta. (2nd trimester: N = 12; 3rd trimester: N = 10). The placental thickness that exceeds the 90th percentile is considered thick (N = 16 in the second trimester and N = 16 in the third).

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Inclusion criteria:
Pregnant women with a single viable pregnancy and an unscared uterus whose age was between 19 and 35.

Exclusion criteria:
Women who were pregnant with any condition that could potentially modify the placenta's dimensions or mass, such as chronic sickness (diabetes, high blood pressure, liver illness, renal illness), recognized congenital fetal defects detected by ultrasonography, many gestations, intrauterine fetal demise (IUFD), a structural problem in the uterus during pregnancy, morbid obesity, abnormal placenta, or placental abnormalities, (BMI > 37), insufficient records, and refusing to participate in the research.

Ethical considerations:
All subjects provided their written informed consent. The Ethics Committee of the GOTHI Research Center approved the research protocol (Ethical approval ID: HD000176). The purpose of this study was to perform research on humans in compliance with the Declaration of Helsinki, the code of ethics of the World Medical Association.

METHODOLOGY

Body mass index (BMI), age, parity, and prior medical history were all evaluated for routine demographic and obstetric data of all participating women in our study. The usage of drugs, alcohol, and smoking were also identified. Transabdominal ultrasonography was used to quantify the placental thickness in the relevant patients at the second (15–20 weeks) and third (between thirty and thirty-four weeks) trimesters. For all sonographic investigations, the Voluson 730 pro-v equipment (GE, Healthcare Austria) with an abdominal transducer frequency of 5-7.5 MHZ was used.

The sonographic method of placental thickness assessment:

The patient lied supine and had a slightly inflated bladder inspected. Following the application of the coupling agent, the transducer was put on the skin's surface. At the cord insertion point level, the placenta's thickness in mm was assessed [(11)].

Due to the distortion caused by tangential scanning, a scan with the transducer positioned perpendicular to the chorionic and basal planes was conducted. The placenta's thickness was determined through assessing it from the echogenic chorionic plate to the placental myometrial interface, which is close to the middle of the placenta. The calculations did not include the vessels beneath the placenta or myometrium.

Following birth, the fetal weight was measured in gm, along with the fetal health, morbidity, and admission to the NICU (involving Apgar scores, distress, or mortality of the fetus). Three subgroups of research participants' placental thicknesses were identified. Normal placental thickness (amongst the 10^{th} and 90^{th} percentiles), thin placenta (less than the 10^{th} percentile), and thick placenta (greater than the 90^{th} percentile) [(12)].

Statistical analysis

The data that were gathered, were reviewed and manually coded. The Statistical Package for the Social Sciences, Version 22 for Windows, was employed to conduct statistical analysis on the numerical codes that were entered into the computer. Quantitative data were presented as range, mean, and standard deviation and qualitative data were presented as number and percentage. The Chi square test (X^2) was employed to compare groups for qualitative data. Nonparametric Kruskal -Wallis and Mann-Whitney tests for quantitative variables which were not normally distributed. The linear associations among the data were assessed using Pearson correlation. A P-value less than 0.05 indicated statistical significance.

RESULTS

According to our study's findings, a strong distinction between normal and abnormal placental thickness can be seen in the fetal outcome. During the second trimester, normal placental thickness had significantly higher birth weight, placental weight, and Apgar score in one and 5 minutes compared to the other 2 groups **(Table 1)**.

Table (1): Association among the normal and abnormal placental thickness in 2nd trimester with birth and placental weight, and Apgar scoring

Variable	Placental thickness in 2nd trimester			F test	P value
	Thin placenta < 17.6 N=12	**Normal placental thickness (17.7-26.2) N=84**	**Thick placenta >26.2 N=16**		
Birth weight (gram) (Mean ±SD)	2822±336.8	3415.8±393	2942±652.4	15.7	**<0.001 P1=<0.001 P2=** 0**.749 P3=<0.001**
Placental weight (g) (Mean ±SD)	465.7±52	538.2±41	448.6±92	26.52	**<0.001 P1=<0.001 P2=0.667 P3=<0.001**
Apgar scoring (Mean ±SD**)**					
Apgar scoring one min	4.2±1.2	7.4±0.9	4.72±1.35	82.2	**<0.001 P1=<0.001 P2=0.502 P3=<0.001**
Apgar scoring five min	6.82±0.89	8.6±0.82	6.15±0.84	73.52	**<0.001 P1=<0.001 P2=0.091 P3=<0.001**

P1: Group 1 vs Group 2
P2: Group 1 vs Group 3
P3: Group 2 vs Group 3

This table shows that the average birth weight, placental weight, and Apgar score in 1 and 5 minutes during the third trimester, were significantly higher with a normal placenta thickness compared to the other 2 groups **(Table 2)**.

Table (2): Association among the normal and abnormal placental thickness in 3rd trimester with birth and placental weight, and Apgar scoring

Variable	Placental thickness in 3rd trimester			F test	P value
	Thin placenta <31.2 N=10	**Normal placental thickness (31.2 -41.7) N=86**	**Thick placenta >41.7 N=16**		
Birth weight (gram) (Mean ± SD)	2741.9±332.3	3304.5±363.7	3058±459	13.31	**<0.001 P1=<0.001 P2=** 0**.097 P3=0.046**
Placental weight (gram) (Mean ± SD)	461.5±49.7	533.2±32	485.2±113.4	13.38	**<0.001 P1=<0.001 P2=** 0.5 **P3=<0.00**3
Apgar score (Mean ± SD**)**					
Apgar score 1 minute	3.6±1.02	7.4±0.91	4.9±1.1	100.1	**<0.001 P1=<0.001 P2=** 0**.008 P3=<0.001**
Apgar score 5 minutes	6.1±0.81	8.6±0.9	6.7±0.79	65.15	**<0.001 P1=<0.001 P2=** 0.21 **P3=<0.001**

P1: Group 1 vs Group 2
P2: Group 1 vs Group 3
P3: Group 2 vs Group 3

This table shows that only 10.7% of patients in the second trimester with normal placental thickness were admissible to the NICU after birth, compared to 58.3% of cases in the thin placenta and 81.25% in the thick placenta **(Table 3)**.

Table (3): Relation between NICU admission and the normal and abnormal placental thickness in 2nd trimester and NICU admission

NICU admission	Placental thickness in 2nd trimester			X^2	P value
	Thin placenta < 17.6 N=12	Normal placental thickness (17.7-26.2) N=84	Thick placenta >26.2 N=16		
Cases admitted	7 (58.3%)	9 (10.7%)	13 (81.25%)	42.22	**<0.001 P1=<0.001 P2=0.18 P3=<0.001**
Not Admitted cases	5 (41.7%)	75 (89.3%)	3 (18.75%)		

P1: Group 1 vs Group 2
P2: Group 1 vs Group 3
P3: Group 2 vs Group 3

This table shows that only 11.6% of third-trimester patients with normal placental thickness were admitted to the NICU, in contrast to 40% of patients for thin placentas and 56.3% of cases for thick placentas **(Table 4)**.

Table (4): Relation between NICU admission and the normal and abnormal placental thickness within the 3rd trimester

NICU admission	Placental thickness in third trimester			X^2	P value
	Thin placenta <31.2 N=10	Normal placental thickness (31.2 -41.7) N=86	Thick placenta >41.7 N=16		
Cases admitted	4 (40%)	10 (11.6%)	9 (56.3%)	19.01	**<0.001 P1=<0.016 P2=0.42 P3=<0.001**
Not admitted cases	6 (60%)	76 (88.4%)	7 (43.7%)		

P1: Group 1 vs Group 2
P2: Group 1 vs Group 3
P3: Group 2 vs Group 3

The placental thickness in the 2nd trimester was significantly positively associated with the placental weight, Apgar score, and fetal birth weight. Additionally, a substantial positive association was found among placental thickness within the 3rd trimester and the Apgar score, placental weight, and fetal birth weight **(Table 5)**.

Table (5): Correlation between placental thickness in 2nd or 3rd trimester and fetal birth and placental weight, and Apgar scoring

	Placental thickness in 2nd trimester		Placental thickness in 3rd trimester	
Variable	Pearson r	p-value	Pearson r	p-value
Birth weight	0.422	0.008	0.364	0.01
Placental weight	0.386	0.01	0.285	0.03
Apgar scoring	0.485	0.002	0.472	0.005

DISCUSSION

The placenta must operate normally for a healthy fetal growth and advancement procedure [4].
Rh-ve pregnancy, intrauterine infections, gestational diabetes, and hydrops fetalis are characterized by thick placentas, while preeclampsia, intrauterine growth restriction, and chorioamnionitis are characterized by thin placentas [13].

The main outcomes of this research were as follows:

According to our research regarding the association among normal and abnormal placental thickness in the 2nd trimester with birth and placental weight, and Apgar scoring, A statistically significant variance was found among placental thickness in the 2nd trimester and birth weight, with a p value of <0.001, while a greatly statistically significant variance was found among placental thickness in 2nd trimester with regard to placental weight and Apgar score for 1 minute and 5 minutes.

In agreement with our results, **Gouda *et al.*** [14] purposed to assess the association among thickness of the placenta during the 2nd and 3rd trimesters and the weight of the fetus and the placenta. They demonstrated that a statistically significant variance was found among placental thickness in 2nd trimester and birth weight with p value <0.05, while a greatly statistically significant variance was found among placental thickness in 2nd trimester with regard to placental weight and Apgar score for 1 minute and 5 minutes with a p value <0.001.

In accordance with our results, **Afrakhteh *et al.*** [15] purposed to examine the association among placental thickness through the 2nd and 3rd trimesters and placental and birth weights. Their research was conducted on 250 singleton pregnant females, and they revealed that a statistically significant variance was found among placental thickness in 2nd trimester and birth weight with a p value of 0.04.

Also, in support of our results, **Shinde *et al.*** [16], who aimed to study the correlation among thickness of the placenta within the 2nd and 3rd trimesters and neonatal findings and maternal weight gain, they revealed that a statistically significant variance was found among thickness of the placenta in the 2nd trimester and birth weight, with a p value < 0.05.

Our findings showed an association among abnormal and normal placental thickness in 3rd trimester, birth and placental weight, and Apgar scoring. A statistically significant variance was found among placental thickness in 3rd trimester with birth and placental weight with a p value <0.05, while a greatly statistically significant variance was found within the placental thickness in 3rd trimester with regard to Apgar scoring one min and five min with a p value <0.001.

In accordance with our research, **Gouda *et al.*** [14] showed that a statistically significant variance was found among placental thickness in 3rd trimester with birth weight and placental weight with a p value <0.05, while a greatly statistically significant variance was detected among placental thickness in 3rd trimester with regard to Apgar scoring one min and five min with a p value <0.001.

Also, in accordance with our results, **Nagpal *et al.*** [17], who aimed to correlate ultra-sonographic placental thickness at thirty-two- and thirty-six-weeks' pregnancy with neonatal and predicted neonatal results from studying placental thickness, revealed a strong association among placental thickness and birth weight, regarding to Pearson's association analysis (r = 0.405 at thirty-two weeks and r = 0.740 at thirty-six weeks), and the Pearson's association coefficient (r) among placental thickness and Apgar scoring at thirty-two weeks was 0.281 and at thirty-six weeks was 0.303 (p value = 0.003), which was statistically significant.

In contrast with our results, **Afrakhteh *et al.*** [15] showed that no statistically significant variance was found among placental thickness in 3rd trimester and birth weight with a p value of 0.1.

Our results revealed that, regarding the relation between NICU admission and normal and abnormal placental thickness in 2nd trimester, a statistically significant variance was found between placental thickness in 2nd trimester and NICU admission, with a p value of <0.001. The cases admitted were 7 (58.3%), 9 (10.7%), and13 (81.25%), while the cases not admitted were 5 (41.7%), 75 (89.3%), and 3 (18.75%), respectively, in the thin placenta, normal placenta, and thick placenta.

Like our results, **Gouda *et al.*** [14] showed that a statistically significant variance was found among placental thickness in 2nd trimester and NICU admission with a p value < 0.05, and the incidence of NICU admission was elevated in both thin and thick placentas.

Our results demonstrated a relationship between NICU admission and normal and abnormal placental thickness within the 3rd trimester. A statistically significant variance was found between placental thickness in 3nd trimester and NICU admission, with a p value of <0.001, and only 11.6% of third-trimester patients with normal placental thickness were admitted to the NICU, in contrast to 40% of patients for thin placentas and 56.3% of cases for thick placentas.

In accordance with our results, **Nagpal *et al.*** [17] demonstrated that a statistically significant variance was found among placental thickness in 3rd trimester with NICU admission, which occurs in 10% of cases with a normal placenta, 75% of cases with a thin placenta, and occurs in all cases with a thick placenta.

Also, **Gouda *et al.*** [14] revealed that a statistically significant variance was detected among placental thickness in 3rd trimester with NICU admission, with a p value <0.05.

Our findings showed a correlation between placental thickness in 2nd and 3rd trimester, birth and placental weight, and Apgar scoring. A significant positive association was detected with p < 0.05 among placental thickness within 2nd and 3rd trimesters with placental weight, Apgar score, and birth weight.

In support of our research, **Afrakhteh *et al.*** [15] documented that a significant positive correlation was detected among placental thickness and birth weight within the 2nd and 3rd trimesters (r = 0.15, p = 0.03, r = 0.14, p = 0.04, respectively). However, placental weight wasn't associated with 2nd and 3rd trimesters' placental thickness (r = 0.005, p = 0.9; r = 0.003, p = 0.9, respectively).

Also, in accordance with our results, **Nagpal *et al.*** [17] found that a strong positive association was found among placental thickness and birth weight regarding Pearson's association analysis (r = 0.55 at thirty-two weeks and r = 0.740 at thirty-six weeks). The Pearson's association coefficient (r) among placental thickness and Apgar scoring at thirty-two weeks was 0.281 and at thirty-six weeks was 0.303 (p value = 0.003), which was statistically significant.

Similarity in constance with our results, **Shinde *et al.*** [16] showed that a significant positive association was demonstrated among birth weight and placental thickness in the 2nd and 3rd trimesters, P<0.00001.

CONCLUSION

Regarding our results, we concluded that measurement of placental characteristics should be a part of all standard prenatal ultrasounds, since placenta thickness can be used in conjunction with other biometric markers to predict neonatal outcomes. Regarding the association among placental thickness within the 2nd or 3rd trimester, a significant positive association was detected with p < 0.05 among placental thickness in the 2nd and 3rd trimesters with placental weight, Apgar score, and birth weight.

DECLARATIONS

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- **Availability of data and material:** Available
- **Conflicts of interest:** No conflicts of interest.
- **Competing interests:** None

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