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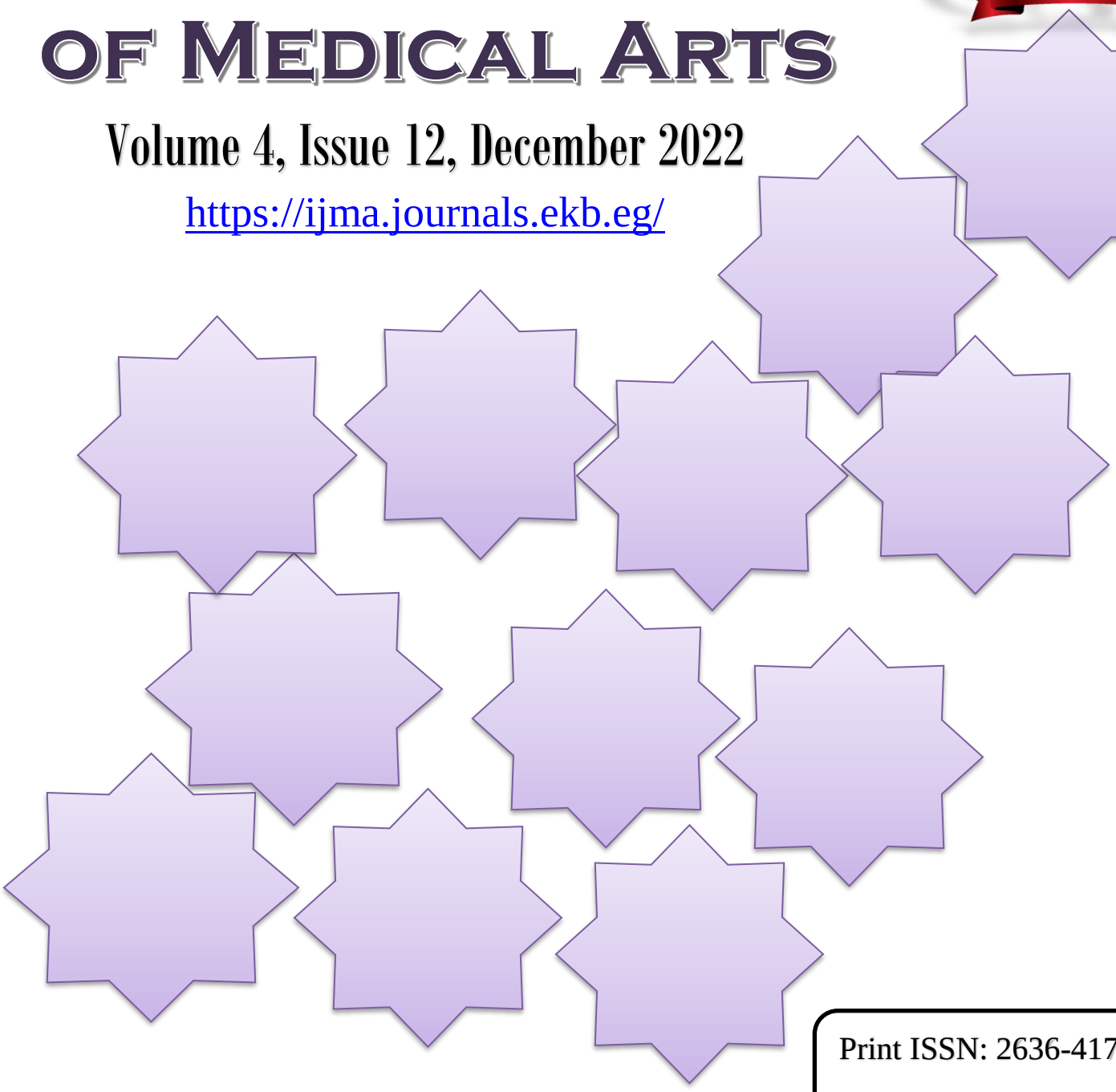

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Original Article

Placental Thickness Measurement and Its Association with Neonatal Outcomes

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ABSTRACT

Background: Placental thickness, measured by ultrasonography, might be an indicator of placental function. Adverse maternal conditions had negative outcomes on the placenta as well as on the fetal growth and maturation; thus, ultrasonographic assessment of placental thickness might be correlated with neonatal outcomes.

Aim of the Work: To clarify whether the two-dimensional ultrasonographic measurements of placental thickness is associated with adverse neonatal outcome.

Patients and Methods: The present observational prospective study included 150 pregnant women, enrolled between the 1st of July 2020 to 1st of January 2021, from Obstetrics and Gynecology Department, Bab Al-Sharia Hospital, Al-Azhar University. Included women aged 18-40 years with singleton pregnancy and normal body mass index [BMI]. They are subjected to ultrasound examination for measuring placental thickness at second trimester [18-24 wk.] and third trimester [36 wk.] of gestation. Post-delivery birth weight of the baby, placental weight and Apgar score were documented, and correlated with the placental thickness.

Results: The mean age among studied patients was 26.22±4.04 years. The mean neonatal birth weight was 3149.1± 496 g, while the average placental weight was 502.4± 58.4 g. Abnormal placental thickness at second and third trimester was associated with significant decrease in neonatal birth weight, lower placental weight and lower APGAR score at one and five minutes.

Conclusion: Placental thickness can be used as an indicator for the prediction of low birth weight and early neonatal outcomes.

Keywords: Birth weight; Two-dimensional ultrasound; Placental thickness.

INTRODUCTION

Good placental implantation, growth and function are very important factors for the normal growth and development of the fetus [1]. Satisfactory intrauterine growth and appropriate neonatal birth weight relies on the effective transportation of nutrients from the maternal blood to the fetus through normally working placenta [2].

Ultrasound [US] allows the assessment of the placenta and the recognition of abnormal placenta by means of various parameters such as the placental thickness [3].

The practice of measuring placental thickness is a somewhat simple and clinically valuable tool, which can be easily repeated in low resources settings [4].

Maternal diseases and adverse conditions affecting the fetus can be suggested by an anomalous size of the placenta, when measured throughout the middle and late stages of pregnancy [5].

Thin placenta is mainly associated with preeclampsia, intrauterine growth restriction and possibly chorioamnionitis [1]. On the other hand, a thick placenta, defined as > 3 cm before 20 weeks of gestation and > 5 cm before 40 weeks of gestation, is seen in Rh-negative pregnancy, gestational diabetes, and intrauterine infections [especially primary maternal Cytomegalovirus infection] [6].

Also, a large placenta may be associated with fetal anemia or Triploidy [there are usually other markers of fetal compromise]. The placenta is pathologically thickened as a result of inflammation, edema or compensatory hypertrophy [7].

The majority of maternal diseases will affect both the fetus and the placenta**.** So, the growth of the fetus and the subsequent neonatal outcome can be detected by measurement of placental thickness [8].

The role of normal and abnormally sized placenta in the prediction of neonatal outcome still remains unclear. Few studies investigated the relation between placental thickness, and subsequent neonatal outcome; however, most of these studies were retrospective in design, or conducted at single-point [9].

Measurement of placental thickness at various gestational ages was documented to be related to birth weight [5]. However; a weak positive correlation was showed between placental thickness in second and third trimesters and fetal weight in these gestations and birth weight [10]. So, there is a need for a follow-up cross sectional prospective study to establish placental growth as a measure of neonatal outcome.

Adverse conditions that affect the fetus also affect the placenta. The placental thickness might be an ultrasonographic simple tool for assessment of fetal well-being. Thus, the aim of this study is to determine the role of two dimensional ultrasonographic measurements of placental thickness in prediction of fetal outcome and birth weight.

PATIENTS AND METHODS

The present observational prospective study included 150 pregnant women, enrolled between the 1st of July 2019 to 1st of January 2020, from Obstetrics and Gynecology Department, Bab Al-Sharia Hospital, Al-Azhar University.

Included women aged 18–40 years, sure of last menstrual period, with singleton pregnancy and had normal body mass index [BMI]. While women with high obstetric risk factors [congenital abnormalities of fetus, low lying placenta or placenta previa, eccentric insertion of the umbilical cord and/or and poor visualization of placenta] were excluded from the study.

Data collection

Pregnant women were included in the first trimester during routine antenatal care visits. The gestational age was estimated based on the date of last menstrual period, and approved by careful ultrasonographic examination. At the inclusion, full history and examinations were obtained. Obstetric history included gravidity, parity, modes of delivery in previous pregnancies, first day of the last menstrual period and gestational age. Medical history included present or past history of any chronic illnesses. The weight, height and BMI were measured.

Regular follow up for included women was carried out through the second and third

trimester. Frequent measurements of weight and BMI and repeated ultrasound examinations were achieved. Second trimester ultrasound was performed between 18-24 weeks of gestation, and accurate time was recorded, while third trimester ultrasound was obtained for all women at 36 weeks of gestation. Women who failed to complete repeated ultrasound examination were excluded from the study.

Ultrasound examination

All ultrasonographic studies were performed trans-abdominally using two-dimensional real-time mode by measures of 3.5 MHZ volume transducer. The fetus was inspected for viability and apparent congenital abnormalities. Placenta was localized in a longitudinal section. The thickness of the placenta is measured longitudinally from the lateral chorionic plate to the umbilical cord insertion site, excluding the posterior placenta, at the umbilical cord insertion level. Percentile of placental thickness for our study population was calculated. The pregnant women with placental thickness and diameter between 10th and 95th percentile was taken as having normal placental thickness and followed up as one group, while pregnant women with thickness below 10th percentile or above 95th percentile was defined to be having abnormally thin or thick placenta and were classified as a separate group and followed up till delivery [5].

Outcomes

The primary outcome is the post-delivery birth weight of the baby. Secondary outcomes include placental weight and Apgar scores at one and five minutes. Placental thickness at 18-24 and 36 weeks was correlated with birth weight and neonatal outcome. An abnormal outcome of pregnancy was defined as a birth weight less than 2,500 g [11].

Ethical considerations

An informed verbal consent from the participants was taken and confidentiality of information was assured. An official written administrative permission letter was obtained from dean of faculty of medicine, hospital managers and the head of the Obstetrics and Gynecology department, Al-Azhar University. The title and objectives of the study were explained to the participants to ensure their cooperation. Permission from local ethical committee was also acquired and approval from institutional review board was taken.

Statistical analysis

Analysis of data was done using "Statistical Program for Social Science version 20 [SPSS Inc. Chicago, IL, USA]". Quantitative variables were described in the form of mean and standard deviation. Quantitative variables were analyzed by Student t test or Mann-Whitney test. Qualitative variables were evaluated using chi-square [X^2] test or Fisher's exact test. Pearson correlation coefficient was used to correlate variables. For all tests, P value < 0.05 is considered significant.

RESULTS

Second trimester ultrasound examination shown that abnormal placental thickness [< 10th or > 95th percentiles] was detected among 22 patients. Follow-up at third trimester revealed 21 patients with abnormal placental thickness vs. 129 patients with normal placenta.

The mean age of studied women was 26.22±4.04 years. Other demographic and anthropometric measures are shown in table [1].

The mean birth weight was 3149.1± 496 g, while the mean placental weight was 502.4± 58.4 g. regarding APGAR score, the mean values at one and five min. were 6.07±1.71 and 8.09±1.52, respectively [Table 2].

There was significant difference between 2nd trimester normal and abnormal placental thickness as regards placental weight [g] [513.35±49.56 vs. 438.55±66.10; P <0.001], 1 min. APGAR score [6.39±1.60 vs. 4.23±1.07; P <0.001] and 5 min. APGAR score [8.41±1.38 vs. 6.23±0.81; P <0.001], and birth weight [g] [3215.7±481.4 vs. 2762.1±400.4; P <0.001] as shown in Table [3].

There was significant difference between 3rd trimester normal and abnormal placental thickness as regards placental weight [g] [509.98±53.38 vs. 455.67±67.35; P 0.002], 1 min. APGAR score [6.27±1.68 vs. 4.86±1.42; P <0.001] and 5 min. APGAR score [8.29±1.49 vs. 6.86±1.11; P <0.001], and birth weight [g] [3192.1±468.0 vs. 2885.4±588.4; P 0.008] as shown in Table [4].

Table [1]: Maternal characteristics of the studied cases

Variables		Results
Residence	Rural	85 [56.7%]
	Urban	65 [43.3%]
Age [years]	Min. – Max.	20.0 – 33.0
	Mean ± SD.	26.22 ± 4.04
	Median [IQR]	27.0 [23.0 – 30.0]
Weight [kg]	Min. – Max.	55.0 – 95.0
	Mean ± SD.	76.19 ± 12.26
	Median [IQR]	77.0 [65.0 – 88.0]
Height [m]	Min. – Max.	1.56 – 1.78
	Mean ± SD.	1.68 ± 0.07
	Median [IQR]	1.68 [1.6 – 1.7]
BMI [kg/m^2]	Min. – Max.	17.36 – 37.65
	Mean ± SD.	27.24 ± 4.84
	Median [IQR]	27.63 [23.4 – 30.9]

IQR: Inter quartile range

Table [2]: Outcomes of the studied cases

Outcomes		Results
Birth weight [g]	<2500	15 [10%]
	≥2500	135 [90%]
	Min. – Max.	1494.0 – 4165.0
	Mean ± SD.	3149.1 ± 496.0
	Median [IQR]	3166.0 [2869.0 – 3578.0]
Placental weight [g]	Min. – Max.	320.0 – 597.0
	Mean ± SD.	502.4 ± 58.4
	Median [IQR]	511.0[478.0 – 542.0]
One-min. APGAR score	Min. – Max.	2.0 – 9.0
	Mean ± SD.	6.07 ± 1.71
	Median [IQR]	6.0 [5.0 – 7.0]
Five-min. APGAR score	Min. – Max.	5.0 – 10.0
	Mean ± SD.	8.09 ± 1.52
	Median [IQR]	8.0 [7.0 – 9.0]

IQR: Inter quartile range

Table [3]: Relation between 2nd trimester placental thickness with outcomes

		2nd trimester placental thickness		Test	P
		Normal [n = 128]	**Abnormal [n = 22]**		
Birth weight [g]	<2500	9 [7%]	6 [27.3%]	χ^2= 8.546*	**0.010***
	≥2500	119 [93%]	16 [72.7%]		
	Min. – Max.	1494.0 – 4165.0	1883.0 – 3241.0	t= 4.175*	**<0.001***
	Mean ± SD.	3215.7 ± 481.4	2762.1 ± 400.4		
	Median [IQR]	3191.0	2827.0		
Placental weight [g]	Min. – Max.	356.0 – 597.0	320.0 – 577.0	t= 5.069*	**<0.001***
	Mean ± SD.	513.35 ± 49.56	438.55 ± 66.10		
	Median [IQR]	516.0	430.50		
One-min. APGAR score	Min. – Max.	2.0 – 9.0	2.0 – 6.0	t= 8.084*	**<0.001***
	Mean ± SD.	6.39 ± 1.60	4.23 ± 1.07		
	Median [IQR]	7.0	4.0		
Five-min. APGAR score	Min. – Max.	5.0 – 10.0	5.0 – 8.0	t= 10.327*	**<0.001***
	Mean ± SD.	8.41 ± 1.38	6.23 ± 0.81		
	Median [IQR]	9.0	6.0		

*: significant at P < 0.05

Table [4]: Relation between 3rd trimester placental thickness with outcomes [n = 150]

		3rd trimester placental thickness		Test	P
		Normal [n = 129]	Abnormal [n = 21]		
Birth weight [g]	<2500	9 [7%]	6 [28.6%]	χ^2= 9.358*	**0.008***
	≥2500	120 [93%]	15 [71.4%]		
	Min. – Max.	1564.0 – 3930.0	1494.0 – 4165.0	t= 2.681*	**0.008***
	Mean ± SD.	3192.1 ± 468.0	2885.4 ± 588.4		
	Median [IQR]	3183.0	3116.0		
Placental weight [g]	Min. – Max.	331.0 – 597.0	320.0 – 577.0	t= 3.520*	**0.002***
	Mean ± SD.	509.98 ± 53.38	455.67 ± 67.35		
	Median [IQR]	515.0	466.0		
One-min. APGAR score	Min. – Max.	2.0 – 9.0	2.0 – 8.0	t= 3.655*	**<0.001***
	Mean ± SD.	6.27 ± 1.68	4.86 ± 1.42		
	Median [IQR]	7.0	5.0		
Five-min. APGAR score	Min. – Max.	5.0 – 10.0	5.0 – 9.0	t= 4.239*	**<0.001***
	Mean ± SD.	8.29 ± 1.49	6.86 ± 1.11		
	Median [IQR]	9.0	7.0		

DISCUSSION

The results of this study demonstrated that abnormal placental thickness was associated with significant reduction of neonatal birth weight and decreased APGAR scores. These findings indicate that much of the conditions affecting the fetus are produced by placental insufficiency. On ultrasonography, a thicker placenta is associated with increased perinatal risk, along with increased mortality linked to fetal malformations, with higher rates for both small and full-term gestational age [12].

In this study, we demonstrated that there was a significant correlation between birth weight and placental thickness measurement during second and third trimesters. Likewise, **Sersam *et al.*** [13] showed that birth weight was positively correlated with placental thickness measured in the second and third trimesters of pregnancy. Similarly, **Ashmawy *et al.*** [14] reported a significant correlation between placental thickness and estimated fetal birth weight [r = 0.899]. They also showed that the person's correlation coefficient between the mean placental thickness and the mean of the actual birth weight was 0.933, proving the significant positive correlation between placental thickness and birth weight. Furthermore, **Miwa *et al.*** [15] found that the values of Apgar score at one minute in the cases with thick placenta were significantly lower than in those without thick placenta. In addition, **Altagy *et al.*** [16] showed statistically significant lower APGAR [l] min and [5] min in patients with thick placenta compared to control group.

Newborns with birth weight < 2500 g were found to have more frequency of abnormal placental thickness, in 2nd and 3rd trimesters, compare to newborns with birth weight > 2500 g. In the same way, **Hamdy *et al.*** [17] showed that cases with low birth weight significantly had lower fetal gestational age, placental thickness and diameter, as well as reduction of all intrauterine growth indicators. **Muraliswar *et al.*** [18] showed that there was a statistically significant positive correlation between sonographic placenta thickness and fetal weight yielding a Pearson's correlation coefficient [r] of 0.902 and 0.856 for the 2nd and third trimesters respectively [P = 0.001]. Also, **Abu *et al.*** [19] reported proportional correlation between placental thickness and estimated fetal weight in the 2nd and 3rd trimesters.

The causes of abnormal placental thickness, including thin [<10th percentile] and thick [>95th percentile], are numerous and studied by many researches. In a study conducted by **Balla *et al.*** [6], the placental thickness was examined by ultrasonography among 53 pregnant women in the 2nd and 3rd trimesters. A thickness below 25 mm in late pregnancy, which is thinner than normal, may be a sign of intrauterine growth retardation, while a thickness of more than 45 mm is considered thicker than normal, and associated with maternal diabetes hypertension and hydrops fetalis. Thus, the presence of abnormal placental thickness might be a useful indicator for identifying fetuses who are at risk for developing adverse outcomes after birth. In this study, we evaluated placental thickness at a relatively early gestational age, which displayed that the majority of patients with abnormal placental thickness during second trimester ultrasound examination remained unchanged. These findings indicate that some adverse

neonatal outcomes may be expected early in pregnancy, which may contribute to the interventional therapeutic decisions concerned for these women.

The strength points of the study include the prospective design and the early measurement of placental thickness, while the main limitation was the use of general reference percentiles for detection of abnormal placental thickness due to the lack of local reference percentiles. In addition, we did not compare between thin vs. thick placenta due to small number of patients with abnormal placental thickness, which may cause statistical bias.

Conclusion: Abnormal placental thickness during second and third trimesters of pregnancy was associated with significant decrease of neonatal birth weight and lower APGAR scores at one and five minutes. Thus, early measurement of placental thickness might be a marker for the prediction of low birth weight and other neonatal outcomes.

Conflict of Interest and Financial Disclosure: None.

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