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Diagnostic Accuracy of Placental Thickness Measured By Ultrasonography In The Detection Of Intrauterine Growth Restricted (Iugr) Babies Keeping Actual Birth Weight As Gold Standard

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Abstract

Objective: To determine the diagnostic accuracy of the placental thickness measured by ultrasound in detecting IUGR babies keeping actual birth weight as the gold standard.

Methods: This cross-sectional validation study was conducted in the Department of Radiology P.O.F Hospital Wah Cantt. The data was gathered over a period of six months, from 06-19-2017 to 12-18-2017. A total of 125 patients were included in this study. All pregnant women were examined by the greyscale and Doppler ultrasonography using a color Doppler scanner with a 5.0 MHz convex probe. Placental thickness was measured as the distance between the echogenic line of the chorionic plate and the hypoechoic myometrium. The pregnant females were followed till childbirth and the weight of the baby at birth was recorded.

Results: Patients ranged between 20-35 years of age. The average age of the study participants was 27.6±3.3 years, the mean gestational age was 34.2±3.0 weeks, the mean BMI was 23.5±1.3 (kg/m2), and the mean parity was 1.1±1.0. We found a sensitivity of 65.5%, specificity of 83.3%, Positive Predictive Value(PPV) of 98.7%, Negative Predictive Value (NPV) of 10.8%, and diagnostic accuracy of 66.4% for antenatal prediction of IUGR based on placental thickness measurement. Stratification for age and gestational age was also carried out.

Conclusion: Placental thickness on ultrasonography can be used as a reliable marker for detecting IUGR babies with an accuracy of 6.4%.

Keywords: Placental thickness, Intrauterine Growth Restriction (IUGR), Ultrasound, Birth weight.

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1. Introduction

The placenta functions to provide nutrition to the fetus and maintains the feto-maternal circulation through the umbilical cord [(1)]. Normal placental functioning is essential for the growth and optimal nourishment of the fetus. Considering the dependency of the fetus on the placenta to fulfill its nutritional requirements, the literature suggests the utilization of placental measurements as a marker for fetal well-being [(2,3)]. Although antenatal care is much improved nowadays, it is disappointing that most low birth weight and intrauterine growth-restricted infants are undiagnosed until delivery. IUGR is regarded as a fetus with markedly reduced weight below the 10th percentile of normal weight for that gestational age [4-6]. 5-10 % of all pregnancies suffer from intrauterine growth restriction. It is a documented cause of perinatal increased morbidity and mortality. The problem is more severe in developing low to middle-income countries (LMIC), having limited resources and insufficient health care (4–6). There is a high risk of distress, hypoxia, mental restriction, metabolic disturbance, hematological issues, necrotizing enterocolitis, and fetal death associated with IUGR. Low birth weight is widespread in developing countries where a majority of pregnant ladies have low socioeconomic status and poor health. A large number of IUGR babies are born in Asia, contributing to 75% of all affected infants [(7)]. In India, the proportion of IUGR is 54%. The actual incidence of IUGR in our country remains unveiled due to a large number of home deliveries where there is no concept of weighing the baby at birth [(8,9)]. An early diagnosis of IUGR is essential and helpful in optimizing antenatal and perinatal feto-maternal care. Studies have shown that a decrease in placental size precedes fetal growth restriction. [(10,11)]

The placental thickness reaches approximately 3 cm at term [(12,13)]. It is reported that there could be an association between IUGR and placental thickness of < 25 mm at term [(14)]. Pre-eclampsia, intrauterine

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infections, and chromosomal anomalies are also seen in pregnancies with small placentas (15–17). In one study conducted in Pakistan, the sensitivity of ultrasound to detect low placental thickness was reported as 86.30% and a high specificity of 86.70%. In this study, the diagnostic accuracy of ultrasound was also reported to be 86.40% [18].

In developing countries like Pakistan, where there is no proper health care system and medical centres are not well equipped, this study will help in the early detection of IUGR babies. The study is also very useful in health centres where Doppler ultrasound is unavailable and compromised blood flow in the umbilical and middle cerebral arteries cannot be assessed.

Sonographically, the definitive placenta can be appreciated by 12 weeks of gestation. Placental volume increases linearly with crown-rump length (CRL) measurements and correlates with maternal serum levels of the placental hormone [19,20]. In the second trimester, the placenta assumes its mature appearance. It is uniform and homogeneous in echo texture. The placenta size is around 12 x 2.5 cm by 18 to 20 weeks of gestation. By the third trimester, the placenta gradually becomes more heterogeneous in texture as pregnancy advances. As small placentas are associated with numerous pathologies, likewise placentas having more than 4 cm thickness are related to issues like fetal hydrops (of both immune and nonimmune aetiology), maternal diabetes, placental chorioangiomas, and intrauterine fetal infections.

Ultrasound is the most sensitive, simple, rapid, and safe tool for diagnosing placental localization and detecting placental anomalies [21]. Among placental measurements, total placental volume is considered the most accurate parameter for assessing placental size. However, placental volume acquisition is a complex method for routine use. In contrast, measuring the placental thickness at the cord insertion level is relatively easy, simple, and has greater clinical utility. This study has focused on measuring the placental thickness and identifying its significance in assessing IUGR.

2. Materials & Methods

The study was initiated after acquiring institutional ethical committee approval.The sample size was calculated by taking a sensitivity of 53.5%, specificity of 92%, and absolute precision of 10% [22].

125 pregnant patients aged between 20 and 35 years with singleton pregnancies suspecting IUGR fetuses were included in the study through non-probability consecutive sampling. Females with irregular cycles, unsure Last Menstrual Period (LMP), having anomalous fetuses, placenta previa, and suffering from chronic illnesses like diabetes, chronic kidney disease, and hypertension were excluded from the study. Informed consent was obtained from all study participants. The study participants were scanned in a supine position between 32 to 36 weeks of gestation with a partially filled bladder using a grey scale and Doppler mode. All scans were performed on a Toshiba Nemio MX scanner with a 5.0 MHz convex probe.

The placental thickness was measured in millimetres at the insertion site of the umbilical cord. The transducer was placed to orient the scanning plane perpendicular to the placenta's chorionic and basal plates. Placental thickness was measured as the distance between the echogenic chorionic plate and the hypoechoic placental myometrial interface. The retroplacental veins and thickness of the myometrial lining were not included in placental measurements. All data were collected in a pre-designed proforma. Patients were followed till delivery to measure birth weight.

The data were analyzed using SPSS (Statistical Package for the Social Sciences) version 23. Mean and standard deviation was calculated for age, gestational age, parity, placental thickness, birth weight, and Body Mass Index (BMI).

The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated using 2 x 2 tables. Effect modifiers like age, gestational age, parity, and BMI were controlled by stratification. Post-stratification diagnostic accuracy was measured.

3. Results

A total of 125 patients were included in the study for six months from 06-19-2017 to 12-18-2017.

In this study, the diagnostic accuracy of the placental thickness measured by Ultrasonography in the detection of IUGR babies keeping actual birth weight as the gold standard was found to be 66.4% with

sensitivity of 65.5%, specificity of 83.3%, PPV 98.7%, and NPV of 10.8%

Table-1 Diagnostic accuracy of placental thickness measurement by ultrasound in the detection of IUGR babies (n = 125)

Ultrasonography (Decreased placental thickness)	IUGR (birth weight) (Gold Standard)		Total
	Positive	Negative	
Positive	78 (TP)	1 (FP)	79
Negative	41 (FN)	5 (TN)	46
Total	119	6	125

Sensitivity: a/a+c x 100=65.5%

Specificity: d/d+b x 100=83.3%

Positive Predictive Value: a/a+b x 100=98.7%

NegativePredictive Value: d/c+d x 100=10.8%

Diagnostic accuracy: a+d/a+d+b+c x 100=66.4%

Patients with ages ranged between 20-35 years. The mean age of the patients was 27.6±3.3 years, the mean gestational was 34.2±3.0 weeks, the mean BMI was 23.5±1.3 (kg/m^2), and the mean parity was 1.1±1.0.

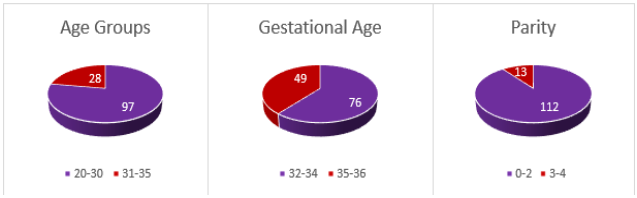

Figure-1. Distribution of patients based on age (a), gestational age (b), and parity (c).

Detailed sensitivity, and specificity based on gestational age and parity were also performed. Diagnostic accuracy for gestational age 32-34 weeks was 64.4%, and for 35-36 was 69.3%.

Detailed stratification and accuracy analysis are given in Table-2 and 3.

Table-2 Post Stratification results of diagnosis on Ultrasonography based on Gestational age.

Gestational Age (Weeks)			IUGR (birth weight) (Gold Standard)		Total
			Positive	Negative	
32-34	Ultrasonography (Decreased placental thickness)	Positive	48 (TP)	1 (FP)	49
		Negative	26 (FN)	1 (TN)	27
35-36	Ultrasonography (Decreased placental thickness)	Positive	30 (TP)	0 (FP)	30
		Negative	15 (FN)	4 (TN)	19

5. Discussion

The placental size increase with the advancing gestational age to meet the nutritional needs of the growing fetus [23].

Abnormal functioning of the placenta leads to compromised fetal growth that can be assessed by measuring placental thickness as placental thickness is directly linked to fetal development.

Hence it can be used as a key marker for the fetal outcome.

It is documented that the placenta measures nearly 3 cm thick at term, whereas its diameter ranges between 15-25 cm [14].

Placental diameter measuring below 15 cm and thickness less than 2 cm is considered the below normal values pivotal to predicting low-birth-weight neonates. [24]

The present study depicts a mean placental thickness of 29.3±5.2 mm between 32-36 weeks of gestational age.

Table-3 Sensitivity, Specificity, Positive predictive value, and Negative predictive value of ultrasound based on gestational age

Gestational Age	Sensitivity	Specificity	PPV	NPV
32-34	64.8%	50%	97.9 %	3.7%
35-36	66.6%	100%	100 %	21.0 %

The results are comparable to a similar study by Baghel et al., which reported a mean placental thickness of 31.8mm [22].

The mean age of our study participants is 27.6 ± 3.3 years, a little higher than documented by Nagpal et al., who reported the mean age of similar study participants as 23.1 ± 3.02 years [25].

The current study revealed that antenatal placental thickness below the 10th percentile demonstrates an increased number of low-birth-weight babies at birth. The positive association of decreased placental thickness with low fetal weight in the third trimester has been documented by Hamdy and Ali in 2020 [26].

Table-4 Post Stratification results of diagnosis on Ultrasonography based on parity.

Parity			IUGR (birth weight) (Gold Standard)		Total
			Positive	Negative	
0-2	Ultrasonography (Decreased placental thickness)	Positive	68 (TP)	1 (FP)	69
		Negative	38 (FN)	5 (TN)	43
3-4	Ultrasonography (Decreased placental thickness)	Positive	10 (TP)	0 (FP)	10
		Negative	2 (FN)	1 (TN)	3

Similar observations have been established by other studies, revealing that low placental thickness is a highly sensitive criterion for predicting LBW neonates [25,27,28]. The study enforced that fetal growth restriction is preceded by reduced placental growth.

Table-5 Sensitivity, Specificity, PPV, and NPV of ultrasound based on parity.

Gestational Age	Sensitivity	Specificity	PPV	NPV
0-2	64.1	83.3	98.5	11.6
3-4	83.3	100	100	33.3

The placental growth adjusts according to the changing in-utero environment. It has been demonstrated that the placenta had a 22mm or less thickness at a gestational age of 36 weeks among babies who weighed <2500gm [29]. They suggested that placental thickness can serve as a measure for determining LBW infants [14,29]. In the present study, the diagnostic accuracy of placental thickness was measured by ultrasonography in detecting IUGR babies keeping actual birth weight as the gold standard. We found a sensitivity of 65.5%, specificity of 83.3%, PPV of 98.7%, NPV of 10.8%, and diagnostic accuracy of 66.4%. The results of the current study are comparable with the conclusions of Baghel et al. [22] In a similar study conducted by Rafique Z et al., the sensitivity, specificity, positive predictive value, and negative predictive value of placental thickness in the determination of IUGR came out to be 86.30%, 86.70%, 75%, and 92%, respectively, documenting higher sensitivity and negative predictive value about our study [18]. This demonstrates that a measure of placental thickness is a useful indicator in predicting IUGR. Thus, it can be concluded that a reduced placental thickness is associated with IUGR.

5. Conclusion

The ultrasound assessment of placental thickness in detecting IUGR babies has a diagnostic accuracy of 66.4%. The placental growth has a direct influence on fetal weight. Therefore, it is wise to utilize placental thickness as a predictor for early detection of IUGR.

CONFLICTS OF INTEREST- None

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Contributions:

F.J, M, A.B, S.U- Conception of study
F.J, M- Experimentation/Study conduction
F.J, M, M.A, A.B, N.G, S.U- Analysis/Interpretation/Discussion
F.J, M.A, A.B, N.G, S.U- Manuscript Writing
F.J, A.B, N.G- Critical Review
M.A, S.U- Facilitation and Material analysis

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