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The correlation of The Placental Thickness, Umbilical Artery Doppler and Fetal growth

Obstetrics & Gynecology

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ABSTRACT

Background: A healthy foetus requires the normal growth of the placenta during the pregnancy. On the other hand,, any disturbance related to its maturation may have a major effect on the fetal growth and the pregnancy outcome.

Aim of the work: To detect the relation between the umbilical artery Doppler, placental thickness, and foetal growing.

Patients and methods: This cross-sectional study conducted at the outpatient clinic of the obstetrics and gynecology department, Al-Azhar University hospitals (assuit) and AL_Eman General Hospital.

Results: At the first visit, there was a strong positive connection between placental thickness and AC, BPD, and HC (r=1.00, p<0.001). At the second visit, There were a notable positivity correlation between placental thickening and estimated foetal weight and umbilical flow by the Doppler (r=1.00, p<0.001).

Conclusion: Estimating the fetal weight is essential in our daily obstetric practice, especially at the third trimester. It helps the obstetricians in making decisions about delivery time and mode of delivery, to protect against the complications of low birth weight and macrosomic babies during labor and puerperium. From the findings of this study, there is measurably critical positive relationship between placental thickness and EFW, BPD, FL, AC and umbilical flow by the Doppler. Estimation of the placental thickness by Ultrasound is a good predictor for foetal growth and birth weight.

Keywords: *Thickness; Umbilical Artery Doppler; Fetal growth; puerperium, Doppler.*

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INTRODUCTION

The thickening of the placenta is caused by the arborization of the existing villi ,but not related to the penetration into the maternal tissues. The improper placental functioning may impact the foetal growth, the affected foetal growth can be diagnosed by abnormal placental measures. So it appears fair that measuring placental thickness may aid in determining proper placental development and function, as well as may act as a good predictor of foetal growth and birth weight.[1]

There are four standard Ultrasound measurements are used to assess the fetal weight: as biparietal diameter, head circumference, abdominal circumference, and femur length. Modern ultrasound scanners use established algorithms and nomograms to convert these four foetal biometric data to an estimated foetal weight (EFW). The existing procedures for determining an EFW demonstrate a good association with actual birth weight; nevertheless, the estimate can vary by up to 20%. [2]

The accuracy of the sonographic estimation of the EFW may be affected by suboptimal imaging and biological variation regardless of the formula applied. Additionally, the accuracy of the sonographic estimation decreases with the increasing birth weight and tends to be overestimated in pregnancies suspected of being large for gestational age (LGA) and underestimated in pregnancies with preterm premature membrane rupture (PPROM) and suspected foetal growth restriction (FGR).[3]

The placental problems of the pregnancy that cause FGR have their pathophysiological origins in the early phases of the placentation and can become evident as early as the end of the first trimester of pregnancy, when the definitive placenta is formed. [4]

Doppler ultrasound waveforms provide information about foetal blood velocity and also offer data on

various aspects of blood flow in a circulation, such as the presence and direction of flow, velocity profile, volume of flow, and resistance to flow. In perinatal practice, umbilical artery Doppler has been extensively used for assessing downstream circulatory resistance (i.e., resistance to flow).[5]

The purpose of the study was to find out the association between foetal growth, placental thickness, and umbilical artery Doppler.

PATIENTS AND METHODS

The research was carried out at the outpatient clinic of the obstetrics and gynaecology department, Al-Azhar University Hospitals (assuit) and AL_Eman General Hospital.

This cross-sectional study was included 150 pregnant female who were referred for ultrasonography unit after ruling out of maternal diseases. Period of study started at November 2019 to November 2021

Inclusion Criteria for study group: Pregnant female age (20_35) years old, BMI (22-28)**,** Primigravida, known last period of regular cycle, gestational age (14_38) weeks according to reliable date for her last menstrual period and ultrasound evaluation and with Singleton living fetus.

Exclusion Criteria for groups: Multiple pregnancies, age below20year and above 35year, BMI below 22 and above 28, negative RHfactor, maternal medical disorders as Gestational Diabetes, Hypertension, anemia and Chronic renal diseases, TORCH infection, fetal anomalies and placenta previa, placental abnormalities.

Methods: Patients were subjected to:

The selected cases were subjected to proper counseling and a very clear explanation of procedure and written consents were received from all the candidates involved in the research.

History taking: Menstrual, Obesteric, past- and family history.

General examination: Weight, Height and Body Mass Index (BMI). **Vital marks** (Blood pressure, Temperature, Heart rate, Respiratory rate) and **marks of** (Pallor, Cyanosis, Jaundice, and Lymph node enlargement)

Chest and heart:

Abdominal examination: Inspection for abdominal contour and scar of previous operations if any and **Palpation:** Superficial for tenderness & rigidity or palpable superficial masses, deep for organomegally , masses & its consistency, **percussion, auscultation**

Laboratory investigation: Complete blood picture (CBC): hemoglobin concentration (Hb %), red blood cells (RBCs), white blood cells (WBCs), platelet count, **RH factor and blood group, random blood sugar and serology for TORCH infection**

Procedure: The pregnant ladies were examined twice during the whole study (the first visit was in the second trimester and the second one was in the last 3 months of the pregnancy).

Ultrasonography evaluation: The pregnant women were examined in the supine position with a moderately distended bladder using a Logic p5 ultrasonography machine with a convex array transducer with 3.5 MHZ power. The biparietal diameter, abdominal circumference, and femur length were measured to determine viability, presentation, gestational age, and expected foetal weight. Using Hadlock's formula, the placental thickness was measured in millimetres, and the transducer was instructed to scan perpendicular to both the chorionic and basal plates, from the echogenic chorionic plate to the placental myometrial interface. Not included in this measurement are the myometrium and subplacental veins. In cases of central or near-central cord insertion, accurate measurements must be taken in the middle of the placenta near the umbilical cord insertion, perpendicular to the uterine wall, from the subplacental veins to the amniotic fluid, excluding the myometrium and any foetal anomalies.

The assessment of foetal growth restriction: is based on disparities between actual and expected sonographic biometric measures for a particular gestational age. On a singleton growth curve, it has traditionally been defined as below 10th percentile weight for gestational age, as this supports the diagnosis as being small for gestational age (SGA). FGR can also be defined as an abdomen circumference below the 10th percentile for gestational age.

Umblical artery Doppler: Patients were put in a semi-recumbent position with a left lateral tilt, and a selected area of the amniotic cavity with numerous loops of cord was visualised by colour Doppler.

Data management and statistical analysis: IBM SPSS statistics (Statistical Package for Social Sciences) software version 22.0, IBM Corp., Chicago, USA, 2013 and Microsoft Office Excel 2007. Computer program was designed for accounting the sample size. Two typed of data are recorded, qualitative data is represented as a number and a percentage, while as quantitative data is represented as a mean and standard deviation. The next measures were used to determine the significance of the variants: correlation by Pearson's correlation or Spearman's correlation. For significant results, the P value was set at 0.05, and for high significant results, it was set at 0.001.

RESULTS

This cross sectional study was managed on 150 gravid females who were referred for ultrasonography at outpatient clinics of Obstetrics and Gynecology Department AL-Azhar University Hospital (Assuit) and AL-Eman General Hospital.

		Ultrasound examination		Test value*	P-value
		First visit (No.= 150)	**Second visit (No.= 150)**		
Gestational age (weeks)	**Mean± SD**	24.34± 1.95	33.01± 2.02	10.64	<0.001
	Median	24.5	33.0		
	Range	21.0- 27.0	30.0- 36.0		
Placental thickness (PT) (mm)	**Mean± SD**	28.91± 3.04	33.92± 3.10	5.001	<0.001
	Median	28.90	34.10		
	Range	17.20- 40.10	27.0- 41.60		
Femur length (FL) (mm)	**Mean± SD**	40.71± 5.32	62.19± 3.76	10.63	<0.001
	Median	41.0	62.0		
	Range	32.0- 50.0	56.0- 69.0		
Abdominal circumference (AC) (mm)	**Mean± SD**	185.73± 22.98	236.05± 23.32	10.41	<0.001
	Median	182.60	234.15		
	Range	147.40- 223.80	193.5- 278.90		
Biparietal diameter (BPD) (mm)	**Mean± SD**	66.25± 6.08	87.62± 6.11	3.04	0.002
	Median	66.80	87.85		
	Range	64.10- 71.20	77.20- 90.20		
Head circumference (HC) (mm)	**Mean± SD**	211.21± 20.71	262.29± 22.02	10.52	<0.001
	Median	210.95	263.60		
	Range	177.30- 249.0	220.6- 307.8		
Estimated fetal weight (EFW) (gm)	**Mean± SD**	621.93± 147.84	1992.69± 362.17	10.62	<0.001
	Median	606.0	2032.0		
	Range	**399.0- 875.0**	**1323.0- 2613.0**		

SD: standard deviation, p≤0.05 is counted significance statistically, p≤0.01 is considered highly significance statistically * Wilcoxon Signed Ranks Test.

Table 1: Evaluation of the studied cases as per fetal biometric measurements and placental thickness at the first and second visit

The mean gestational age in our studied cases at the first and second visits was 24.34± 1.95 weeks and 33.01± 2.02 weeks respectively. The mean placental thickness at the first and second visits was 31.91± 3.04 mm and 33.92± 3.10 mm respectively. The mean Biparietal diameter at the first and second visits was 66.25± 6.08 mm and 87.62± 6.11 mm respectively. The mean Head circumference at the first and second visits was 211.21± 20.71 mm and 262.29± 22.02 mm respectively. The mean estimated fetal weight at the first and second visits was 621.93±147.84 grams and 1992.69± 362.17 grams respectively. Table (1)

		Doppler indices		Test value*	P-value
		First visit (No.= 150)	**Second visit (No.= 150)**		
Resistive index (RI)	**Mean± SD**	0.48± 0.02	0.63± 0.01	10.62	<0.001
	Median	0.48	0.63		
	Range	0.44- 0.51	0.61- 0.65		
Pulsatility index (PI)	**Mean± SD**	1.10± 0.03	0.94± 0.03	10.63	<0.001
	Median	1.10	0.94		
	Range	1.05- 1.16	0.88- 0.99		
S/D ratio	**Mean± SD**	3.46± 0.14	2.78± 0.13	10.62	<0.001
	Median	3.46	2.77		
	Range	**3.22- 3.71**	**2.58- 3.0**		

SD: standard deviation p≤0.05 is counted significance statistically, p≤0.01 is considered highly significance statistically * Wilcoxon Signed Ranks Test.

Table 2: Distribution of the studied cases as Doppler indices findings

The mean Pulsatility index (PI) at the first and second visits was 1.10± 0.03 and 0.94± 0.03 separately and the mean S/D ratio at the first and second visits was 3.46± 0.14 and 2.78± 0.13 respectively. There were statistical significance increase of Resistive index (RI) at the second visit compared to at first visit while there were statistical significance decrease of Pulsatility index (PI) and S/D ratio at the second visit compared to at first visit. Table (2)

	Placental thickness	
	r	p- value *
Gestational age	.988	**<0.001**
Femur length (FL)	.998	**<0.001**
Abdominal circumference (AC)	1.000	**<0.001**

Biparietal diameter (BPD)	1.000	**<0.001**
Head circumference (HC)	1.000	**<0.001**
Estimated fetal weight (EFW)	1.000	**<0.001**
Resistive index (RI)	-1.000	**<0.001**
Pulsatility index (PI)	-1.000	**<0.001**
S/D ratio	**-1.000**	**<0.001**

p≤0.05 is counted significance statistically, p≤0.01 is counted highly significance statistically, r: Correlation coefficient, * Spearman correlation test

Table 3: The relationship between placental thickness and patient characteristics during the initial visit.

There was very high significantly positive relation in-between placental thickness at first visit and Gestational age, FL, AC, BPD, HC and EFW (r=1.00, p<0.001). There was very high significantly negative relation in-between placental thickness at first visit and RI, PI, S/D ratio (r= -1.00, p<0.001). Table (4)

	Placental thickness	
	r	p- value *
Gestational age	.989	**<0.001**
Femur length (FL)	.997	**<0.001**
Abdominal circumference (AC)	1.000	**<0.001**
Biparietal diameter (BPD)	1.000	**<0.001**
Head circumference (HC)	1.000	**<0.001**
Estimated fetal weight (EFW)	1.000	**<0.001**
Resistive index (RI)	-0.999	**<0.001**
Pulsatility index (PI)	-1.000	**<0.001**
S/D ratio	**-1.000**	**<0.001**

p≤0.05 is counted significance statistically, p≤0.01 is counted highly significance statistically, r: Correlation coefficient, * Spearman correlation test

Table 4: The relationship between placental thickness and patient characteristics during the Second visit.

There was very high significantly positive relation in-between placental thickness at second visit and Gestational age, FL, AC, BPD, HC and EFW (r=1.00, p<0.001). There was very high significantly negative relation in-between placental thickness at second visit and RI, PI, S/D ratio (r= -1.00, p<0.001). Table (5)

	EFW	
	r	p- value *
Resistive index (RI)	-1.000-	**<0.001**
Pulsatility index (PI)	-1.000-	**<0.001**
S/D ratio	**-1.000-**	**<0.001**

p≤0.05 is counted significance statistically, p≤0.01 is counted highly significance statistically, r: Correlation coefficient, * Spearman correlation test

Table 5: Correlation between estimated fetal weight at first visit and doppler indices

There were very high significance negativity link in-between estimated fetal weight at first visit and Resistive index (RI) (r=- 1.00, p<0.001), Pulsatility index (PI) (r=-1.00 p<0.001) and S/D ratio (r=-1.00 p<0.001). Table (6)

	EFW	
	r	p- value *
Resistive index (RI)	-1.000-	**<0.001**
Pulsatility index (PI)	-1.000-	**<0.001**
S/D ratio	**-1.000-**	**<0.001**

p≤0.05 is counted significance statistically, p≤0.01 is counted highly significance statistically, r: Correlation coefficient, * Spearman correlation test

Table 6: Correlation between estimated fetal weight at second visit and doppler indices.

There were very high significance negativity link in-between estimated fetal weight at second visit and Resistive index (RI) (r=- 1.00, p<0.001), Pulsatility index (PI) (r=-1.00 p<0.001) and S/D ratio (r=-1.00 p<0.001). Table (6)

DISCUSSION

This cross-sectional trial was distinguished at the outpatient clinic of the department of the obstetrics and gynecology AL-Azhar University, Assuit. and AL_Eman General Hospital on 150 pregnant female who were referred for ultrasonography unit after ruling out of maternal diseases. The duration of the study ranged from 6-12 months.

The present study showed that the mean placental thickness at the first and second visits was 31.91± 3.04 mm and 33.92± 3.10 mm respectively. The mean femur length at the first and second visits was 40.71± 5.32 mm and 62.19± 3.76 mm respectively.

According to Ashmawy et al., [6] the mean and the median of the measured fetal parameters (BPD, HC, FL, and AC) and the gestational age based on each parameter calculated by the ultrasound machine according to Hadlock formula. Mean PBD of the studied cases was 9.45±0.49 cm, the median was 9.48 (9.31-9.64) cm and the mean gestational age calculated from PBD measured was 38.66±1.03 wks and the median was 38.71(37.86-39.43) wks.

The current study showed that the mean Resistive index (RI) in our studied cases at the first and second visits was 0.48± 0.02 and 0.63± 0.01 respectively. The mean Pulsatility index (PI) at the first and second visits was 1.10± 0.03 and 0.94± 0.03 respectively and the mean S/D ratio at the first and second visits was 3.46± 0.14 and 2.78± 0.13 respectively. There were statistical significannce increase of Resistive index (RI) at the second visit compared to at first visit while there were statistical significance decrease of Pulsatility index (PI) and S/D ratio at the second visit compared to at first visit.

In contrast to our findings, El-Mashad et al., 7 found no statistically significant change in umbilical artery Doppler with time in their investigation. Changes in sample size and inclusion criteria could explain the disparity between their study and ours.

In the current study, there was a strong positive connection between placental thickness and femur length at the first visit (r=0.988, p0.001). At the first visit, there was a strong positive connection between placental thickness and AC, BPD, and HC (r=1.00, p0.001).

Our findings were backed up by a study by Ali Abou Zeid et al., 8 who found a link between increased Placental thickness (mm) in the Total sample, 2nd trimester, and 3rd trimester and GA, with GA increasing Placental thickness. The average GA 26 was 34.93 3.57, while the average GA >26 was 36.50 3.07. Placental thickness increases when GA levels rise.

The mean of placental thickening elevated with progressed gestational age, nearly matching from the 22nd to the 35th week and 27 to 33 weeks, respectively. 9

Subnormal placental thickness for a gestational age may be the earliest indicator of foetal growth retardation, which makes a useful association between placental thickening and growth indicators. 10

There were also a positivity link between rising placental volume and increasing pregnancy age, although it was reduced in the growth-restricted foetuses. 11

Furthermore, Adhikari et al., 12 discovered that there was a significant positive relationship between placental thickness and FL, BPD, and AC in the second and third trimesters, with all parameters having identical interactions with placental thickness.

Our findings matched those of Pawan et al., 14 who discovered that the maximal mean placental thickness at the 26th week is 29.76 2.163 mm and at the 38th week is 38.12 2.09 mm. demonstrating a very linear rise in placental thickness with foetal weight (r=079, p =0001: r =0.50, p =0.004).

The current research found a link between placental thickness during the initial visit and Doppler indices. The placental thickness at the initial visit was found to have a highly significant negative relationship with the Resistive index

However, there were no statistically significant associations between placental thickness and umbilical artery PI, RI, and S/D in Aydn & Bulut's 15 investigation.

We can deduce from the findings of this study that placental thickness has a demonstrably significant positive relationship with EFW, BPD, FL, AC, and umbilical course stream as determined by Doppler. A good indicator equipment for determining foetal weight is a U/S calculation of placental thickness.

CONCLUSION

The estimation of foetal weight is crucial to our daily obstetrical practise, particularly in the third trimester. It aids obstetricians in making decisions regarding the time and method of delivery in order to prevent difficulties associated with low birth weight and macrosomic infants during labour and puerperium. Study may conclude from the results of this study that there is a demonstrably significant positive link between placental thickness and EFW, BPD, FL, AC, and umbilical course Doppler stream. Estimation of placental thickness by U/S is a reliable method for determining foetal weight.

Conflict of interest : none

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