Aswan University Medical Journal volume 1 / No.2/ December 2021 (85-91) Online ISSN: 2735-3117

ORIGINAL ARTICLE

First-Trimester Placental Thickness for Prediction Preeclampsia or Small Gestational Age

Fatma Mortada Ali[1], AbdouSaeed Ait-Allah[2], Mohamed Ali Abdelrahman[3], Nahla waer Alsayed Shady[4]

[1]Resident of Obstetrics and Gynecology, Edfu General Hospital, Aswan, Egypt

[2]Professor of Obstetrics and Gynecology, Faculty of Medicine, Sohag University, Egypt

[3]Lecturer of Obstetrics and Gynecology, Faculty of medicine, Aswan University, Egypt
[4]Assistant Professor of Obstetrics and Gynecology, Faculty of medicine, Aswan University, Egypt

ABSTRACT

Keywords:

First-Trimester Placental Thickness, Preeclampsia, Small Gestational Age

***Corresponding Author:**

FatmaMortada Ali, Resident of Obstetrics and Gynecology, Edfu General Hospital, Aswan, Egypt
e-mail:eng_ahmed_66@yahoo.co
Phone No.01099075376

Background: The human placenta develops with the principal function of providing nutrients ' and oxygen to the fetus. **Objective:** The study aimed to evaluate the relation between first-trimester Maximal placental thickness (MPT) and the subsequent risk of preeclampsia and small gestational age (SGA) neonate. **Methodology:** 152 pregnant women were enrolled, standard routine antenatal care at Aswan university Hospital obstetrics and Gynecology Department: three visits were recorded after admission. The 1st the follow up was in2nd trimester and the 2ndfollow up in 3rd trimester. In each visit the following was measured: Fetal biometry (BPD, FL, AC), estimated fetal body weight, amniotic fluid index (AFI). Clinical findings: blood pressure, lower limb edema and biochemical analysis for proteinuria. They were followed up till delivery, where maternal and fetal outcomes were assessed. **Results:** The ultra-sonographic data showed that, the patients developed pre-eclampsia had significantly decreased placental thickness, higher uterine artery index on the first visit, higher umbilical artery index in the second and third trimesters, lower post-delivery placental weight, and lower post-delivery fetal weight when compared with patients without pre-eclampsia. The participant with SGA had significantly thinner placenta, higher uterine artery index on the first visit, higher umbilical artery index in the second and the third trimester, lower post-delivery placental weight, and lower post-delivery fetal weight when compared with women without SGA. **Conclusion:** This study concluded that the placental thickness is powerfully correlated to small gestational age and preeclamptic toxemia development however integration of various Doppler indices would raise the value of maximal placental thickness in prediction of small for gestational.

INTRODUCTION

The human placenta develops with the principal function of providing nutrients ' and oxygen to the fetus**.**

Adequate fetal growth and subsequent normal birth weight depend on the efficient delivery of nutrients from the mother to the fetus via normally functioning utero- placental organ. It is clear that normal development of placenta during gestation is necessary for a healthy fetus. On the other hand, any impairment in its development may have a profound impact on fetal development and pregnancy outcome**.**

Preeclampsia and fetal growth restriction (FGR) are two obstetrrical complications commonly associated with both gross and histopathologic placenta abnormalities. An early detection of intrauterine of growth restriction (IUGR) will be beneficial to obstetric and neonatal care **.**

So Fetal weight estimation is very important because a large proportion of perinatal mortality is related to birth- weight. Thus, birth-weight is the single most important parameter that determines neonatal survival. Obstetric ultrasonography offers the tools to estimate fetal weight and assess placental size**.**

Several authors have evaluated the utility of sonographic assessment of placental morphology in the first and second trimester as an independent predictor of preeclampsia and FGR. As pregnancy complicated by FGR, they are typically associated with smaller placental weight after delivery**.**

Placental thickness is the easiest placental dimension to measure by using 2D ultrasound at first trimester as two-dimensional (2D) placental measurements have exhibited potential utility for predicting adverse outcomes in certain high – risk patients. A simple measurement of maximum placental thickness(/MPT) using two- dimensional ultrasound at the time of the 11–14 weeks' ultrasound could be a reasonable alternative to estimate placental size., it will be observed that first-trimester placental thickness correlated with birthweight**.**

PATIENTS AND METHODS

Type of the study:

Prospective Observational Cohort Study.

Sittings:

The study participants were recruited from the outpatient obstetrics clinic of Aswan University Hospital during one year duration in the period between the 1st of March 2018 to the end of February 2019.

Study participants:

All pregnant women presented to above Hospital. Those who were eligible for participation and accept to share in the study were signed a written informed consent. This was done after reading the patient information sheet or reading them upon her and explaining the contents to the patients including the nature of the study. The study protocol had been approved by the Aswan Medical School Ethical Review board.

Inclusion criteria were, Singleton pregnancy,gestational age from 11to14wks and reliable last menstrual period.

Exclusion criteria:Congenital anomalies eg,anencephaly,multi fetal gestation,reliable last menstrual period or not known,obesity and pendulous abdomen and fibroid complicating pregnancy.

In addition to standard routine antenatal care in obstetric clinic: three visits were recorded after admission. The 1st the follow up was in2nd trimester and the 2ndfollow up in 3rd trimester.

In each visit the following was measured: Fetal biometry (BPD, FL, AC), estimated fetal body weight, amniotic fluid index (AFI). Clinical findings were measured: blood pressure, lower limb edema and biochemical analysis for proteinuria.

Mode of delivery was recorded: vaginal or cesarean section was reported

The APGAR score was used at one minute and five minutes from the time of birth. APGAR measures babies colour the heart rate, reflexes, muscle tone and respiratory effort each category is scored with 0,1 or 2 depending on the observed condition. Anormal Apgar

score is 7 to 10 means a newborn is in good to excellent conditionusually only requiring routine post delivery care.

Statistical analysis:

Statistical analyses were carried out using the R Studio© software (The R Foundation, Vienna, Austria) version 1.0.153, which uses the R programming language for statistical computing. Statistical analysis of the data was sought in two steps: descriptive statistics, and inferential statistics. Continuously variable indices are presented as either mean with standard deviation or as median with interquartile range (IQR), as distribution demands. P-value < 0.05 was considered significant, P-value < 0.001 was considered as highly significant, P-value > 0.05 was considered insignificant.

RESULTS

The demographic data of included participants showed that the median age and BMI of the women was 24.5 years and 25, respectively. The majority of women were primigravida, rural inhabitants, uneducated and housewives as shown in (table 1).

The ultrasound findings in the first and second follow up calculate the mean **±(SD)** and the median of FL, BPD, AC, AFI and EFBW and umbilical artery index mean **± (SD) and the median** to calculate the gestational age, growth follow up and estimation of presence of small for age if developed as shown in (table 2).

The ultra-sound data of the participants revealed that the patients developed pre-eclampsia had significantly decreased placental thickness, higher uterine artery index on the first visit, higher umbilical artery index in the second and third trimesters, lower post delivery placental weight, and lower post delivery fetal weight when compared with patients without pre-eclampsia as shown in (table 3).

The participant with SGA had significantly thinner placenta, higher uterine artery index on the first visit, higher umbilical artery index in the second and the third trimester, lower post delivery placental weight, and lower post delivery fetal weight when compared with women without SGA as shown in (table 4).

The neonatal outcome after delivery using the APGAR score found that, there were no statistically significant difference in the APGAR score at one and five minutes between patients without pre- eclampsia versus those with pre-eclampsia (table 5).

There was no statistically significant difference in the APGAR score at one and five minutes between patients without SGA versus those with SGA (table 6).

DISCUSSION

Preeclampsia and fetal growth restriction are critical obstetric clinical scenarios raising the concerns of obstetricians in every day clinical practice revealed and displayed to be correlated to gross and histopathologic placental pathologies. Placental thickness tends to gradually increase with gestational age in a linear fashion. Sonographically, this can be seen to be approximately 1 mm per week and the thickness of the placenta can be used to approximate gestational age ***(Tongsong and Boonyanurak, 2004).***

Clinical findings in conjunction with uterine artery Doppler on the other hand great variability and differences exist as regards, in the causative placental pathophysiological changes in fetal growth restriction and preeclampsia a growing research interest was to determine the placental biometric measurements, weight and morphological changes obtained sonographically in correlation to predictability capacity in detection of early onset of preeclampsia and fetal growth restriction. Gestations affected by fetal growth restrictive issues are usually and classically coexisting with smaller placental weight after delivery ***(Schwartz et al., 2014; Kovo et al., 2013).***

The current research study findings revealed and displayed that as regards the correlation between small for gestational age and cases age, BMI, CRL there was no statistical significant correlation, consecutively

whereas correlation between SGA and placental thickness within first visit was statistically significant and statistically insignificant in correlation to fetal.biometry.biparital diameter in second and third trimester, femur length in second and third trimester, furthermore correlation between SGA and fetal. Biometry, umbilican artery (AI) in second and third trimester, amniotic fluid index in second and third trimester, Post delivery fetal weight and placental weight was statistically significant.

In agreement with the current research study as regards the relation between the placental thickness and neonatal birth weight ***(David et al., 2016)***showed that there was statistically significant difference between placental volume and neonatal birth weight in spite of using the placental volume not placental thickness, Taking in consideration that measuring the placental thickness more easy and less time consuming and may be done by 2D ultrasound but placental volume needs 3D ultrasound ***(Zeisel et al., 2016).***

In accordance with study showed that there was a statistically significant result between the placental volume and the neonatal birth weight but come with sample size 543 participants compared with our study 152 participants which give the same statistically significant results which enforce our results which are easy placental measurements.

In disagreement with this study ***(Effendi et al., 2014; Suri et al., 2013)*** showed that there was positive correlation between placental thickness and the incidence of preeclampsia as he noticed that increased the incidence of preeclampsia in cases with increased placental thickness in the first trimester and showed that there was inverted correlation between the incidence of small gestational age with the placental thickness as he noticed that increased incidence of small gestational age with decreased placental thickness in the first trimester. There was no explanation for his notification about the increase of placental thickness in cases of preeclampsia and the normal placenta in cases of preeclampsia with small gestational age as this results not matched with the literature, as placental pre eclamptic toxemia combined with placental pathology which lead to decreased placental thickness and usually lead to decreased fetal weight.

In accordance with ***(Poon et al., 2013; Plasencia et al., 2011)*** they showed that there was positive correlation between the placental thickness and small gestational age outcome babies and noticed that the placenta was larger and flatter. The possible explanation of that may be the reduction in elaboration of peripheral nutrient- and gas-exchanging terminal villi in placentas of severely growth-restricted fetuses a condition now described by pathologists as distal villous hypoplasia***(Gomez et al., 2005).***

In accordance to the study there was positive correlation between the uterine artery index and the incidence of preeclampsia and small gestational age with agreement with the study ***(De Paco et al., 2014)***showed that there was positive correlation between the umbilical artery index was statistically significant with small gestational age.

CONCLUSION

The current research have shown that the placental thickness is powerfully correlated to small gestational age and preeclamptic toxemia development however integration of various Doppler indices would raise the value of maximal placental thickness in prediction of small for gestational age development fetal biometry and follow up remains the corner stone sonographic tool in diagnosis of growth restricted fetuses parity and case age are not correlated to placental weight and thickness denoting that age and parity don't affect placental development as independent factors.

Authors' contributions

Fatma mortada Ali (acquisition of data, analysis and interpretation of data, and drafting the manuscript)
AbdouSaeedAit-Allah (study design and revising manuscript critically for important intellectual content)

Mohamed Ali Abdelrahman(interpretation of data, and revising manuscript)

NahlawaerAlsayed Shady (interpretation of data, and revising manuscript)

All authors have approved the final article for submission

REFERENCES

Afrakhteh M, Moeini A, Taheri MS, Haghighatkhah HR (2013): Correlation between placental thickness in the second and third trimester and fetal weight. Revistabrasileira de ginecologia e obstetricia.; 35(7):317-22.

Brett KE, Ferraro ZM, Holcik M, Adamo KB (2015): Prenatal physical activity and diet composition affect the expression of nutrient transporters and mTOR signaling molecules in the human placenta. Placenta; 36(2):204-12.

David AL, Jauniaux E (2016): Ultrasound and endocrinological markers of first trimester placentation and subsequent fetal size. Placenta; 40:29-33.

De Paco C, Ventura W, Oliva R, Miguel M, Arteaga A, Nieto A, Delgado JL (2014): Umbilical artery Doppler at 19 to 22 weeks of gestation in the prediction of adverse pregnancy outcomes. Prenatal diagnosis; 34(7):711-5.

Effendi M, Demers S, Giguere Y, Forest J, Brassard N, Girard M, Gouin K, Bujold E (2014): Association between first-trimester placental volume and birth weight, Placenta 35: 99-102.

Gomez O, Martinez JM, Figueras F, Del Rio M, Borobio V, Puerto B, Coll O, Cararach V, Vanrell JA (2005): Uterine artery Doppler at 11–14 weeks of gestation to screen for hypertensive disorders and associated complications in an unselected population. Ultrasound in Obstetrics and Gynecology; 26(5):490-4.

Karthikeyan T, SubramaniamRK, Johnson WM, Prabhu K (2012): Placental thickness & its correlation to gestational age &foetal growth parameters-a cross sectional ultrasonographic study. Journal of clinical and diagnostic research: JCDR; 6(10):1732.

Njoku M, Peter DS, Mackenzie CF (2015): Haemoglobin-based oxygen carriers: indications and future applications. British journal of hospital medicine; 76(2):78-83.

Poon LC, Syngelaki A, Akolekar R, Lai J, NicolaidesKH (2013): Combined screening for preeclampsia and small for gestational age at 11–13 weeks. Fetal diagnosis and therapy; 33(1):16-27.

Salavati N, Smies M, Ganzevoort W, Charles AK, ErwichJJ, Plösch T, GordijnSJ (2019): The possible role of placental morphometry in the detection of fetal growth restriction. Frontiers in physiology; 9:1884.

Schwartz N, Sammel M, Leite R, Parry S (2014): First-trimester placental ultrasound and maternal serum markers as predictors of small- for-gestational-age infants. American journal of obstetrics and gynecology; 211(3):253-e1.

Tongsong T and Boonyanurak P (2004): Placental thickness in the first half of pregnancy. J Clin Ultrasound; 32 (5): 231-4.

Zeisel C, Müller J, Putora PM, Schneider T, Brutsche M, Baty F, Markus A, Kick J (2016): Handheld single photon emission computed tomography (handheld SPECT) navigated video-assisted thoracoscopic surgery of computer tomography-guided radioactively marked pulmonary lesions. Interactive cardiovascular and thoracic surgery; 23(3):345-50.

Zhang EC, Burton GJ, Smith SK, Charnock-Jones DS (2002): Placental vessel adaptation during gestation and to high altitude: changes in diameter and perivascular cell coverage. Placenta; 23: 751–762.

Table (1): Maternal demographic data in the whole sample (*n*=152)

Variable	Statistic
Age in years, median (IQR)	24.5 (21-30.2)
BMI in kg/m^2, median (IQR)	25 (22-30)
Parity, *n* (%)	
Primigravida	60 (39.4 %)
Multigravida	52 (34.4%)
Grand multigravida	40 (26.3%)
Residence, *n* (%)	
Rural	92 (60.5%)
Urban	60 (38.4%)
Educational level, *n* (%)	
Illiterate and 1ry school	92 (36.2%)
2nd and high school	60 (63.8%)
Occupation, *n* (%)	
Housewife	100 (65.8%)
Employee	52 (34.2%)

Table (2): Ultrasound findings; Umbilical artery Index, FL, BPD and AFI of the participants on the first and the second follow up in the whole sample (*n* = 152)

	First follow up		Second follow up	
	Mean ±(SD)	Median (IQR)	Mean ±(SD)	Median (IQR)
Umbilical artery index	0.71 ±(0.4)	0.6 (0.4 – 0.9)	0.73±(0.4)	0.5 (0.3 – 0.8)
FL, in mm	56±(13)	58 (45 – 67)	64 ±(11.6)	64 (54 – 74)
BPD, in mm	78 ±(16)	80 (65 – 91)	90±(6.2)	91 (86 – 93.5)
AFI, in cm^3	13 ±(8)	12 (10 – 13.5)	12 (2)	11 (10 – 13)
AC, in mm	188 ±(19)	187.2 (171.4-204.8)	313 ±(31)	312 (285.5-341.2)

EFBW, in grams	1067 ±(419)	1031.5(729.5-1434)	2711±(706)	2661 (2087-3248)

Table (3): Comparison between ultrasonographic finding of study participants with pre-eclampsia (*n*=20) and with out pre-eclampcia (*n*=132)

	Patients without PE Median (IQR)	**Patients with PE Median (IQR)**	***p*-value**
Placental thickness on the first visit, in mm	0.8 (0.6 – 0.8)	0.6 (0.5 – 0.9)	0.04*
Uterine Artery Index (UAI)	0.4 (0.6 – 0.9)	1.1 (0.6 – 1.6)	<0.001*
Umbilical artery Index at 2nd trimester	0.6 (0.4 – 0.9)	0.85 (0.5 – 1.8)	0.04*
Umbilical artery Index at 3rd trimester	0.5 (0.3 – 0.7)	0.6 (0.6 – 1.8)	0.04*
Post Delivery Placental weight	510 (460 – 560)	450 (420 – 512)	0.04*
Post Delivery Fetal weight	3100 (2700 – 3525)	2850 (2500 – 3200)	0.03*

Table (4): Characteristics of the patients with and without small gestational age (SGA)

	No SGA (*n*=130)	**With SGA (*n*=22)**	***p*-value**
Placental Thickness	1.08 (1.05 – 1.35)	0.6 (0.5 – 1.05)	0.04*
Uterine artery index (UAI)	0.6 (0.4 – 0.9)	1.7 (1.5 – 1.8)	<0.001*
Umbilical artery Index at 2nd trimester	0.6 (0.4 – 0.9)	1.9 (1.82 – 1.91)	<0.001*
Umbilical artery Index at 3rd trimester	0.5 (0.3 – 0.7)	1.8 (1.79 – 1.87)	<0.001*
Post Delivery Placental weight	500 (460 – 560)	420 (412 - 442)	0.003*
Post Delivery Fetal weight	3100 (2700 – 3500)	2150 (1800 – 2500)	<0.001*

Table (5): Comparison between APGRA score at one and five minutes in patients without pre-eclampsia with those in patients with pre-eclampsia

	No pre-eclampsia	**Pre-eclampsia**	**P- value**
(One-minute) **ABGAR score, median (IQR)**	8 (7 – 8)	7 (6 – 8)	0.12
(Five-minute) **ABGAR score, median (IQR)**	9 (6 – 8)	9 (6 – 9)	0.19

Table (6): Comparison between APGRA score at one and five minutes in patients without SGA with those in patients with SGA

	No SGA	**With SGA**	***p*- value**
One-minute ABGAR score Median (IQR)	7 (6 – 8)	8 (6 – 8)	0.16
Five-minute ABGAR score, Median (IQR)	9 (6 – 8)	9 (6 – 9)	0.22