Second and Third Trimester Placental Thickness: Correlation with Placental and Birth Weights

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ABSTRACT:

BACKGROUND:

The placenta is a materno-fetal organ; it is closely related to the fetus and the mother, it acts like a mirror, reflecting the statuses of both the mother and the fetus. Placental evaluation by ultrasound has been used to characterize placental morphologic changes as the placenta matures. Using different parameters such as placental thickness, weight, and volume have exhibited significant and positive relationship with gestation and birth weight.

OBJECTIVE:

To investigate the relationship between placental thickness during the second and third trimesters and placental and birth weight.

METHODS:

This Prospective Longitudinal study involved pregnant women who presented at Al-Yarmouk Teaching Hospital antenatal clinic. All recruited women were assessed at their 1st trimester visit for baseline demographic and obstetrical data. At the second and third trimesters, maternal weight, weight gain, body mass index, body mass index gain, placental thickness measured by ultrasound, and thickness change were recorded. Statistical analysis was performed to establish the degree of relationship between placental thickness and placental and birth weights.

RESULTS:

Of 150 recruited participants, 100 women were able to complete the study. The mean maternal age was 32.1±4.2 years. Ultrasonographic measures of placental thickness in the second and third trimesters and thickness changes between them were 2.44±0.57, 3.58±0.59 and 1.14±0.38 cm respectively. Values of mean birth and placental weights were 3433± 350.99, and 457.95±46.82 grams respectively. A significant positive correlation was found between placental thickness and birth weight in the second and third trimesters ($r=0.0237$, $p=0.018$, $r=0.399$, $p<0.001$) respectively.

CONCLUSION:

According to the present study, birth weight has a positive correlation with both second and third trimester placental thickness; however, placental thickness change could not predict low or high birth weights.

KEY WORDS: placental thickness, trimester, birth weight

INTRODUCTION:

The placenta is a highly specialized organ with a limited life span [(1)]. Adequate fetal growth and subsequent normal birth weight depends on the efficient delivery of nutrients from the mother to the fetus via normally functioning utero-placental organ [(2)]. The definitive placenta demonstrates a uniformly granular echogenic pattern on ultrasound, is clearly visible from 9-10 weeks of gestation [(3)]. It is thought that abnormalities of placental growth may precede abnormalities in fetal growth [(4)]. Placental thickness is the easiest placental dimension to measure and could therefore play a potential role in screening for complications during pregnancy. Historically, a placenta of greater than 4 cm in thickness has been regarded as abnormal and associated with various poor outcomes [(5)]. Diseases and abnormalities affecting fetus; can be indicated by an abnormal size of the placenta during the second and third trimesters [(6)]. Sonographically thick placentas are associated with maternal diabetes mellitus, hypertension, fetal

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hydrops, and other abnormalities [7, 8]. It seems reasonable to serially evaluate second and third trimesters placental thickness by ultrasound, to determine its reproducibility as a predictor of fetal growth and birth weights.

The aim of this prospective longitudinal study was to establish the relationship between placental thickness during the second and third trimesters and placental and birth weights.

MATERIALS AND METHODS:

This prospective longitudinal study was carried out at the Department of Obstetrics and Gynecology in cooperation with the Department of Radiology and Imaging, of Al-Yarmouk Teaching Hospital Baghdad, Iraq. This study was conducted over a period of eleven months starting from the first of March 2014 to the end of January 2015. The study was approved by the Ethics Committee of our hospital and an informed verbal consent was obtained from each woman before participation in the study. A total of 150 pregnant women aged between 15 and 45 years presented at the antenatal clinic of Al-Yarmouk Teaching Hospital were enrolled in this study. The exclusion criteria were systemic illness or genetic abnormality, for example, sickle cell disease, morbid obesity, multiple pregnancy, fetal congenital abnormality, those with missing records and unwilling to incorporate in the study. Of those 150 women, only 100 were able to complete the study. All recruited women were observed from the 1st trimester at the antenatal clinic and assessed for baseline demographic and obstetrical data including age, parity, body mass index (BMI), past medical events like chronic hypertension, diabetes mellitus, renal disease, smoking, alcohol and drug use was also obtained. A thorough physical, abdominal and obstetrical examination was done at each trimester. All participants were seen during their entire pregnancy for their antenatal care follow up till their delivery at our hospital and any existing pathological abnormalities like preeclampsia, gestational diabetes mellitus (GDM) were recorded. At the second and third trimester particularly (15–20 and 30–34 weeks of gestation respectively), the maternal weight, weight gain, BMI, BMI gain and full data of ultrasound examination were recorded.

All pregnant women underwent ultrasound evaluation of placental thickness at the time of second trimester (15–20 weeks of gestation) as well as third trimester (30–34 weeks of gestation) The examinations were carried-out trans-abdominally using Simens Acuson 300, CH5-2 (3-6MHz) ultrasound device, Germany. The placental thickness was measured by placing the ultrasound transducer perpendicularly to the plane of the placenta, in the area of the cord insertion, near the mid-placental portion as described by Hoddick et al [9]. Certain difficulties were encountered while measuring placental thickness like when the fetus lie with its back on the placenta the measurement looks wrongly smaller, also the uterus should be free of contraction to avoid taking wrong measure. In these situations, a repeated placental thickness measurement at another time was taken. Each evaluation was performed by one experienced sonographer with minimum inter- and intra-observer variability.

At the time of delivery, after assessment of maternal weight, the birth weight (in grams), fetal sex and mode of delivery were recorded also the placenta was weighed in grams as described by Azpurua et al [2]. The placental weight was measured by an electronic baby weighing scale within one hour after placental delivery. The umbilical cord was clamped at its placental insertion to prevent loss of fetal blood. The placenta washed under running tap water. The membranes were carefully trimmed at the placental margin. Fetal and neonatal status and morbidity were also recorded including Apgar scores, fetal distress or neonatal death and admission to the neonatal intensive care unit.

Statistical analysis:

Each patient assigned a serial identification number. The data were reviewed, cleaned with double check entry into the computer using Statistical Package for Social Sciences (SPSS) version 20. The categorical data presented as frequency and percentages tables. The continuous variables were presented as means and standard deviations. Analysis of variance (ANOVA) and independent t-test were used accordingly to assess the significance of placental thickness differences between the characteristics of the study sample. Pearson's correlation test was used to assess the correlation between the placental thickness in both second and third trimester and neonatal birth weight and placental weight , the correlation was considered weak when the coefficient of correlation (r) (0-0.3), moderate if(r=0.3-0.7) and strong when (r>0.7). Statistical significance was considered whenever the P value was less than 0.05.

RESULTS:

In the present study, the baseline characteristics of pregnant women at first visit are summarized in table 1. Twenty three (23%) women had history of previous disease including hypertension, and diabetes mellitus. Labour characteristics and delivery outcome data are shown in table 2. Three fourths of pregnant women had no problems before their delivery while 16% developed preeclampsia and 9% had gestational diabetes mellitus. The delivery mode was normal vaginal delivery in 60 women (60%) and caesarean section in 40 cases (40%). Of the total 100 delivered neonates, 56% of them were males and 81% of the total sample delivered between 36-40 weeks, 15% delivered before 36 weeks and only 4% delivered after 40 weeks of the gestation. Concerning the neonatal birth weight of the delivered babies, the majority of them (85%) weighted between 2500-4000 grams, 9% weighted below 2500 grams, and only 6% were above 4000 grams. Apgar scores in the first minute after birth were lower than 4 in 17% of the neonates while 11% remained in critical condition as their Apgar scores were less than 7 at five minutes and needed admission to neonatal intensive care unit (NICU). About 3% of the neonates in this study died, while 97% left hospital in stable condition soon or after spending several days in the NICU, as shown in table 2. In this study, maternal parameters were evaluated in the second trimester of the pregnancy, the mean weight was (69.08± 8.11) kg, and the mean body mass index was (26.81± 3.49) kg/m^2, with mean BMI gain of (1.15± 0.56) kg/m^2, while the mean of placental thickness measured by ultrasound was (2.44± 0.57) cm as shown in table3.The pregnant women were also assessed in the third trimester, the mean weight was (73.05± 7.74) Kg, and the mean body mass index was (28.36± 3.42) kg/m^2, with mean gain of (2.7± 0.83) kg/m^2, while the mean placental thickness measured using ultrasound was (3.58± 0.59) cm and mean thickness change between the second and third trimester was (1.14± 0.38) cm as shown in table 4.

Table 5 show the distribution of participants according to the means of maternal weight, birth weight, placental weight and gestational age at delivery. The mean maternal weight was (74.63± 7.86) kg, neonatal birth weight was (3433±350.99) grams while the placental weight mean was (457.95± 46.82) grams and the mean gestational age at the delivery was 37± 2.18 weeks. The placental thickness in the second and third trimesters of pregnancy was evaluated for all the included women, with a comparison of thickness mean in both trimesters as well as mean differences between them according to the maternal characteristics. The placental thickness in the second and third trimesters were significantly higher ($p=0.003$ and $p=0.001$ respectively), in maternal age group 30-35 years compared to other age groups while there was no significant difference between the three age groups in the thickness change between the two trimesters. Also, neither second nor third trimester thickness showed significant differences between maternal body mass index groups, with no significant differences in the thickness changes.

The placental thickness was shown to be significantly higher among females with past history of hypertension in both second and third trimesters ($p<0.001$ and $p=0.003$ respectively) in comparison to other categories of past history, nevertheless, no significant differences in thickness change were observed among the categories. Concerning placental thickness differences according to pre-labour maternal problems, these measures were significantly higher in women who complained of preeclampsia compared to those with gestational diabetes and others who did not suffer from any gestational problems in the second, and third trimesters ($p=0.001$ and $p=0.006$ respectively). Also, placental thickness change was significantly higher among patients with preeclampsia ($p=0.004$) as shown in table 6

The comparison of placental thickness in the second and third trimesters as well as the changes between them according to gestational age, mode of delivery, gender of the neonates and their birth weight, were shown in table 7. There were no significant differences in any of the three parameters between the gestational age categories at delivery. Pregnant women who delivered by caesarean section had significantly the highest placental thickness in the second trimester ($p=0.022$) in comparison with those delivered by normal vaginal delivery, in reverse the placental thickness change between the second and the third trimester was significantly higher among those with normal delivery ($p=0.007$). The results also showed that placental thickness in both second and third trimesters were significantly higher among women who gave birth to female neonates than those delivered males ($p<0.001$ and $p=0.001$ respectively), still no significant differences in

placental thickness changes were observed between both neonatal genders. Women who gave birth to neonates with birth weight (2500-4000) were shown to have the thickest placentas in the second and third trimesters as compared with those under or over weighted neonates, and these differences were significant (p=0.008, p=0.003 respectively), while there was no significant difference in placental thickness change among the birth weight groups. As it can be observed in table 7, high placental thickness was significantly associated with low first and fifth minutes Apgar scores among the neonates in this study in both second and third trimesters (p< 0.001) and the placental thickness changes between the trimesters were higher in low Apgar scores in both first and fifth minutes (p=0.003 and p=0.002 respectively). The table also showed that stillbirth and those who needed admission to NICU were associated with thick placenta.

There was a significant positive correlation between placental thickness and birth weight in the second and third trimesters (r=0.237, p=0.018; r=0.399, p<0.001 respectively). On the other hand, placental weight did not correlate with both second and third trimester's placental thickness (r=0.161, p=0.109; r=0.101, p=0.316 respectively), as shown in table 8.

Table 1: Main characteristics of pregnant women at the time of presentation, n=100.

Variables	Mean±(SD)	
Age (years)	32.1±(4.2)	
Maternal weight (Kg)	66.1±(8.1)	
Height (cm)	161.0±(6.0)	
Body mass index (Kg/m^2)	25.7±(3.7)	
		No. (%)
Gravida	1	13 (13.0)
	2	26 (26.0)
	≥3	61 (61.0)
Para	0	17 (17.0)
	1	26 (26.0)
	2	21 (21.0)
	≥3	36 (36.0)
Previous diseases	No problems	77 (77.0)
	Hypertension	12 (12.0)
	Diabetes Mellitus	11 (11.0)

Table 2: Labour characteristics and delivery outcome data, n=100.

Variables		No.	%
Mode of delivery	Normal vaginal delivery	60	60%
	Caesarean section	40	40%
Peri-labour problems	No problems	75	75%
	Preeclampsia	16	16%
	Gestational Diabetes Mellitus	9	9%
Gender of the fetus	Female	56	56%
	Male	44	44%
Gestational age	<36 weeks	15	15%
	36-40 weeks	81	81%

	41-42 weeks	4	4%
Birth weight (grams)	<2500	9	9%
	2500 - 4000	85	85%
	>4000	6	6%
Apgar score 1st min	<4	17	17%
	≥4	83	83%
Apgar score 5th min	<7	11	11%
	≥7	89	89%
NICU admission	Yes	11	11%
	No	89	89%
Stillbirth	Yes	3	3%
	No	97	97%

Table 3: Average of maternal weight, body mass index and gain since the presentation as well as the placental thickness in the second trimester, n=100.

Variables	Mean±(SD)
Maternal weight (kg)	69.08±(8.11)
Body mass index (kg/m^2)	26.81±(3.49)
Body mass index gain (kg/m^2)	1.15±(0.56)
Placental Thickness (cm)	2.44±(0.57)

Table 4: Average of maternal weight, body mass index and gain since the presentation as well as the placental thickness in the third trimester, n=100.

Variables	Mean±(SD)
Maternal weight (kg)	73.05±(7.74)
BMI (kg/m^2)	28.36±(3.42)
BMI gain (kg/m^2)	2.7±(0.83)
Placental Thickness (cm)	3.58±(0.59)
Thickness change (cm)	1.14±(0.38)

Table 5: Average of maternal, birth and placental weights as well as gestational age at delivery, n=100.

Variables	Mean±(SD)
Maternal weight (kg)	74.63±(7.86)
Birth weight (grams)	3433±(350.99)
Placental weight (grams)	457.95±(46.82)
Gestational age (weeks)	37.24±(2.18)

Table 6: Comparison of the placental thickness in the second, third and changes between them according to maternal age, BMI, previous diseases and pre-labour abnormalities, n=100.

Variables	Placental thickness 2nd trimester		Placental thickness 3rd trimester		Placental thickness change	
	Mean±(SD)	p-value	Mean±(SD)	p-value	Mean±(SD)	p-value
Maternal age (years)[a]						
<30 years	2.2±(0.5)	0.003*	3.4±(0.5)	0.001	1.2±(0.3)	0.301
30-35 years	2.6±(0.4)		3.8±(0.6)		1.1±(0.4)	
>35 years	2.3±(0.8)		3.3±(0.6)		1.0±(0.5)	
Maternal BMI in the booking visit[b]						
<25 (kg/m2)	2.5±(0.7)	0.573	3.6±(0.6)	0.923	1.1±(0.4)	0.341
≥25 (kg/m2)	2.4±(0.4)		3.6±(0.5)		1.2±(0.4)	
Previous diseases [a]						
No disease	2.4±(0.5)	<0.001	3.5±(0.6)	0.003	1.1±(0.4)	0.6
Diabetes Mellitus	2.5±(0.5)		3.5±(0.5)		1.0±(0.1)	
Hypertension	2.9±(0.3)		4.1±(0.6)		1.1±(0.6)	
Pre-labour maternal abnormalities [a]						
No disease	2.1±(0.6)	0.001*	3.2±(0.6)	0.006	1.1±(0.4)	0.004*
Gestational DM	2.5±(0.5)		3.6±(0.5)		1.2±(0.1)	
Preeclampsia	2.7±(0.4)		3.7±(0.6)		1.5±(0.5)	

[a]ANOVA test, [b] Independent t-test,* significant at alpha<0.05 level (2-tailed).

Table 7: Comparison of the placental thickness in the second, third and changes between them according to gestational age, mode of delivery, gender of the fetus, birth weight,Apgar score in 1st minute, in 5th minute, Neonatal care unit admission, Stillbirth. n=100.

Variables	Placental thickness 2nd trimester		Placental thickness 3rd trimester		Placental thickness change	
	Mean±(SD)	p-value	Mean±(SD)	p-value	Mean±(SD)	p-value
Gestational age at delivery [a]						
<36 weeks	2.4±(0.5)	0.578	3.8±(0.7)	0.233	1.2±(0.3)	0.447
36-<40 weeks	2.5±(0.6)		3.6±(0.5)		1.1±(0.4)	
40-42weeks	2.2±(0.5)		3.1±(0.4)		0.9±(0.3)	
Mode of delivery[b]						
NVD	2.3±(0.6)	0.022*	3.5±(0.6)	0.597	1.3±(0.4)	0.007*
CS	2.5±(0.5)		3.6±(0.5)		1.0±(0.4)	
Gender of the fetus[b]						
Male	2.2±(0.5)	<0.001	3.4±(0.6)	0.001*	1.2±(0.5)	0.143
Female	2.6±(0.5)		3.7±(0.5)		1.1±(0.3)	
Birth weight(gm)[b]						
<2500	2.2 ±(0.4)	0.008*	3.5 ±(0.3)	0.003*	1.3 ±(0.1)	0.401
2500-4000	2.9 ±(0.7)		4.1 ±(0.9)		1.2 ±(0.3)	
>4000	2.5±(0.5)		3.6 ±(0.2)		1.1 ±(0.2)	
Apgar score 1st min						

<4	2.9±(0.4)	<0.001	4.1±(0.7)	<0.001	1.2±(0.2)	0.003*
≥4	2.4±(0.3)		3.3±(0.4)		1.1±(0.1)	
Apgar score 5th min						
<7	2.7±(0.4)	<0.001	3.9±(0.7)	<0.001	1.2±(0.2)	0.002*
≥7	2.3±(0.2)		3.3±(0.4)		1.0±(0.2)	
Neonatal care unit admission						
Yes	2.6±(0.7)	0.002*	3.9±(0.9)	0.001*	1.2±(0.3)	0.004*
No	2.3±(0.2)		3.3±(0.5)		1.0±(0.2)	
Stillbirth						
Yes	2.9±(0.3)	0.012*	4.0±(0.5)	0.02*	1.1±(0.2)	0.395
No	2.3±(0.4)		3.3±(0.5)		1.0±(0.2)	

[a]ANOVA test, [b] Independent t-test, * significant at alpha<0.05 level (2-tailed).

Table 8: Correlation between (the placental thickness in the second and third trimester) and (the placental and birth weight), n=100.

Variables		Placental thickness 2nd trimester	Placental thickness 3rd trimester
Birth weight (grams)	Pearson Correlation	0.237	0.399
	p-value	0.018*	<0.001**
Placental weight (grams)	Pearson Correlation	0.161	0.101
	p-value	0.109	0.316

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION:

The wellbeing of the fetus is affected by many factors but a healthy placenta is the single most important factor in producing a healthy baby. Pregnancy outcome depends on placental morphology, and its efficiency to transfer nutrients, gases, waste products, heat, hormones, and other regulatory molecules [10, 11]. Ultrasonographic placental thickness measurements appear to be of value as a relatively simple and clinically useful way to detect early warning signs which could be done in any unequipped obstetrical centre [12].

Regarding the relation between placental thickness and maternal age, our study show a significantly higher placental thickness in the second and third trimesters (p=0.003 and p=0.001 respectively) especially in the age group (30-35 years). Our results partially agree with those reported by Balla et al who found a linear relation between maternal age and placental thickness, in the second and third trimesters [13], but disagree with those reported by Miwa et al, who noted a lack of relation between placental thickness and maternal age [14].

In our study, a significant relation was also found between placental thickness in the second and third trimester and pre pregnancy diseases in the mother mainly hypertension and diabetes mellitus. Regarding pre-labour problems, also a significant relation was found between the increase in the placental thickness in the second and third trimesters and change between them and gestational diabetes mellitus and preeclampsia, this means that thick placenta can identify the presence of pathological conditions, this was also observed in studies done by other researchers [15, 16,]. Raio et al. [16] reported that abnormally thick placentas have been correlated with adverse pregnancy outcome. Classically, histological studies of type 1 diabetic placentas have described grossly abnormal placentas that are enlarged, thick, and plethoric, with abnormalities of villous maturation [17]. These changes would all support the increased incidence of placental-related complications observed in diabetic pregnancy [18]. Although the pathophysiology of preeclampsia is poorly understood, it is characterized by abnormal trophoplast invasion of uterine blood vessels, immunological intolerance between feto-placental and maternal tissues [19], also inflammation, oedema, compensatory hypertrophy may occur. On the other hand, Kuhlmann and Warsof [20] reported that severe diabetes and hypertension were associated with thin placenta.

In our study a significant relation was found between placental thickness in the second trimester and thickness change and caesarean mode of delivery. This can be explained that most cases of caesarean delivery in our study were because of maternal or fetal complications which necessitate urgent delivery and as we know that placental thickness increase in the presence of these complications, these results partially agree with those obtained by Miwa et al [14], in their study, a linear relation was found between placental thickness in the second and third trimester and caesarean mode of delivery.

According to our results, a significant relation was found between placental thickness and delivering a female baby, this may be explained by small sample size and more female babies in our study; this finding was in consistent with those reported by Balihallimath et al [10]. But disagree with the findings obtained by Afrakhteh et al [21], who reported no relation between placental thickness measured during pregnancy and baby gender. In our study, no relation was found between placental thickness in the second and third trimester and placental weight after delivery, these results agree with those reported by Afrakhteh et al [21].

In our study, a weak positive correlation was observed between placental thickness in the second and third trimesters and birth weight, mainly in birth weight (2500-4000), this was also observed by Afrakhteh et al [21]. Still, we didn't find a relation between thick placenta and low or high birth weights, this might be explained by small sample size in our study. This disagree with the findings by Elchalal et al [21,22] , who reported a higher percentage of thick placentas in birth weight at term above 4000 gm or less than 2500 gm. Also in another study done by londhe et al showed that placental diameter and thickness measurements are valuable parameters for predicting low birth weight infants [23]. In our study, a significant relation was found between thick placenta and adverse perinatal outcome, this was also found by other researches who described an association between thick placentas and increased risk of adverse perinatal outcome, e.g. abruptio placentae, admission to neonatal intensive care unit, congenital anomalies, perinatal death, pregnancy-induced hypertension (PIH), low Apgar scores, number of emergency cesarean section deliveries, , intrauterine fetal demise (IUFD), and gestational diabetes mellitus (GDM) [15,16,22,24]. These abnormalities are closely related with placental dysfunction. Indeed, placental infarction, intervillous thrombosis, and inflammation were often detected in thick placenta by pathological examination [15,16,22]. Placental dysfunction may also result in thick placenta by the compensatory proliferation and edema of placental villi [16,]. Conversely, Thompson et al. found no correlation between a thick placenta and poor obstetrical outcome, apart from a mild association with severe preeclampsia [79].

CONCLUSION:

According to the present study, birth weight has a positive correlation with both second and third trimester placental thickness; however, placental thickness change could not predict low or high birth weights.

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