

ULTRASONOGRAPHIC CORRELATION OF PLACENTAL THICKNESS WITH FETAL GESTATIONAL AGE AND GRADING OF PLACENTAL MATURITY

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ABSTRACT

AIMS AND OBJECTIVES

Comparative correlation of placental thickness with foetal gestational age, and evaluation of placental maturity by ultrasonography.

MATERIALS AND METHODS

The study includes 100 normal singleton gestations between 10 to 40 weeks of gestation referred to our centre for routine antenatal ultrasound examination. All the women were evaluated by transabdominal ultrasonography. Foetal gestational age in weeks was determined by crown rump length, biparietal diameter, head circumference, abdominal circumference and femoral length. Placental thickness was measured in millimeters. All the placentae were graded using ultrasonographic grading system.

RESULTS

Our observations revealed that the placental thickness gradually increased from 11.8 mm at 12 weeks to 38.5 mm at 39 weeks. Placental thickness almost corresponds to advancing gestational age exhibiting a linear and direct growth. Progressive maturity changes were noted in placenta with advancing gestational age.

CONCLUSION

Placental thickness measured at cord insertion site can be used as one of the parameter for estimating foetal gestational age. Placental thickness measurement can also be used to differentiate certain abnormal conditions related to thick and thin placenta. Ultrasonographic placental grading helps to rule out certain conditions associated with premature or delayed placental maturation.

KEYWORDS

Placental thickness, Gestational age, Ultrasonography.

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INTRODUCTION: Umbilical cord is the main link between foetus and the mother. At the mother side it is attached with uterine wall with broad based placenta. Placenta takes care of all the physiological functions of the foetus. It protects the foetus acting as a barrier between mother and foetus. Placenta is being primarily a foetal organ and its size is reflection of foetal health. Placental formation begins along with the implantation of blastocyst and grows with the foetus till term. It is expelled with the foetus at the time of birth. Oxygenated maternal blood enters placenta through branches of uterine artery and is supplied to the foetus through umbilical arteries and deoxygenated blood returns to maternal circulation through umbilical vein. The umbilical cord is attached on the foetal surface at or near its centre of the placenta.

The matured placenta is seen as a discoid soft tissue mass weighing around 450 grams with a diameter of 15-20 cm. The uterine surface is rough and shaggy. It is divided into lobes by fissures. Each lobe consists of several cotyledons, which are the basic units of the placenta. The foetal surface of the placenta is smooth and is closely invested by a thin glistening amnion overlying the chorion.

Placental evaluation was not possible till the introduction of Ultrasonography (USG). Its evaluation began with the grey scale USG. USG has revolutionized the process of placental evaluation. It is useful to know position, morphology, various disorders and localization of umbilical cord. USG has provided a safe and non-invasive means of evaluation of normal or abnormal sized placenta, its appearance and growth pattern etc. With advances in grey scale and colour Doppler it is now possible to study utero-placental blood flow and foetal growth.

Presently the most effective way of dating pregnancy is by USG. Accurate assessment of foetal gestational age is essential in obstetric practice for a good perinatal outcome. Several USG parameters are used to date pregnancy. They are CRL (crown rump length), BPD (Biparietal Diameter), HC

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(Head Circumference), AC (Abdominal Circumference) and FL (Femoral Length). Placental thickness measured at the level of umbilical cord insertion can be used as a new parameter to estimate foetal gestational age. The measurement of placental thickness is relatively simple and clinically useful. Many workers have studied the role of placental thickness as a parameter for estimating gestational age and nomograms in relation to gestational age has been published.¹ Placental thickness measurement can easily differentiate normal from abnormal conditions related to thick and thin placenta.

USG is very sensitive and simple non-invasive tool to evaluate placental morphology, localization, abnormalities and growth pattern. Transabdominal USG can visualize placenta around 8 weeks of gestational period. From 10 to 12 weeks onwards placenta is clearly apparent on USG. There after placenta undergoes changes in size as well as in echotexture till term. Grannum and associates have reported the textural characteristics of the developing placenta. These changes in the maturing placenta are used for placental grading. USG grading of placenta requires evaluation of basal plate, placental substance and chorionic plate and is graded as follows.²

Grade 0: The earliest placental grade with a smooth well defined chorionic plate, homogeneous placental tissue and regular basal plate.

Grade 1: The chorionic plate shows subtle undulations, basal plate will be regular and placental substance shows few linear reflective spot like densities.

Grade 2: The chorionic plate undulation extends into the placental substance but do not reach the basal plate. Placental tissue shows randomly dispersed echoes. Along the basal plate linear echogenic densities are noted (calcium deposits).

Grade 3: The chorionic plate undulations reach the basal plate. The placental septae are deposited with calcium which will surround the lobes (cotyledons) with echo spared areas in the centre.

Normally all placenta starts as grade 0. Grade 0 placenta is typically seen in less than 28 weeks of gestation. The mean gestational age at which the placenta matures to grade 1 is 31 weeks, grade 2 is 36 weeks and grade 3 is 38 weeks as seen by others as well.³ Only 15 to 20% of placenta will reach a grade 3 status at term. It is said that maturation of the placenta does not occur at the same rate and same degree in all pregnancies.² Placental maturity may be accelerated or delayed in certain conditions. Accelerated ageing may be seen in intrauterine growth retardation or preeclampsia. Delayed maturity may be seen in gestational diabetes and Rhesus incompatibility.

In the present study, our aim is to measure the placental thickness at the level of cord insertion, further to evaluate the relationship of the placental thickness with the gestational age and to assess the placental maturity with advancing gestational age.

MATERIALS AND METHODS: This cross sectional prospective study includes 100 normal pregnant women with uncomplicated singleton gestations in the group of 10 to 40 weeks of gestation, referred to our diagnostic centre for routine antenatal ultrasound examination. The study was carried out between September 2015 to December 2015. Consent was taken from all the patients prior to USG examination. All the gestations were examined transabdominally in supine position by GE Logic P5 Doppler ultrasound system with 3.5 MHz curvilinear probe and images were recorded on Sony thermal printer. The gestational age was determined by CRL up to 12 weeks and later by BPD, HC, AC & FL. The average gestational age was recorded in weeks.

The placental thickness was measured at the level of cord insertion site, perpendicular to the uterine wall at the maximum thickness noted in the cross section. The placental thickness was measured from the echogenic chorionic plate to the placento-myometrial interface. The myometrium and the retroplacental veins were excluded. All the placental measurements were taken during the relaxed myometrial state and recorded in millimeters. Grading of all the placenta were done as per the USG grading system to assess the growth pattern of placenta with advancing gestational age.¹

History of regular menstruation with last known menstrual period was noted. Unknown last menstrual period and patients with irregular menstrual periods, placental variations like morphological variations, variations in umbilical cord insertions, placenta previa, poorly visualized placenta, foetal anomalies, Intrauterine growth retardation and multiple gestations were excluded from the study. Maternal diseases like diabetes, hypertension, anaemia, etc., Amniotic fluid variations like oligohydramnios and polyhydramnios were also excluded from the study.

RESULTS: Among the total 100 pregnant women included in the study, the age group ranged between 18 to 38 years, with a mean age of 23 years. Majority of the women were belonging to the age group of 21 to 30 yrs. Of them 59 were gravida-1, 36 gravida-2, 4 gravida-3 and 1 was gravida-4. 60 were primiparaous and 40 were multiparous. Out of the 100 singleton gestations 55 foetuses were in cephalic, 15 in breech and 30 in unstable presentations. Out of 100 placentae, 44 were anterior, 45 posterior, 8 lateral wall and 3 fundal in location [Table 1].

Position	Number	Percentage
Anterior	44	44%
Posterior	45	45%
Lateral	08	08%
Fundal	03	03%
Total	100	100%

Table 1: Placental position distribution

		PT	GA
PT	Pearson Correlation	1	.996**
	Sig. (2-tailed)		.000
	N	100	100
GA	Pearson Correlation	.996**	1
	Sig. (2-tailed)	.000	
	N	100	100

Table 2: Statistical analysis

**correlation coefficient $r=0.996$, p value < 0.001 .

Placental Thickness: Among the total 100 placental thickness measurements, gestational age wise frequency ranged from 1 to 9 cases for each gestational age. The mean value of placental thickness along with respective standard deviation was calculated for all gestational ages from 11 to 39 weeks. The mean placental thickness gradually increased from 11.8 mm at 12 weeks to 38.5 mm at 39 weeks of gestation. From 12 to 39 weeks of gestation, the placental thickness in millimeters was almost matched with the gestational age in weeks. However, at no stage of pregnancy was the normal placenta measured greater than 40 mm.

The mean placental thickness was 23.84 ± 9.58 mm, and mean gestational age was 23.85 ± 9.38 . The standard deviation for gestational age and placental thickness are 9.38 and 9.58. The minimum and maximum gestational age is 10 and 39 weeks, the minimum and maximum placental thickness is 9 mm and 40 mm respectively. Correlation coefficient $r = 0.996$ and p value < 0.001 [Table-2], showing a strong and linear relationship with placental thickness and gestational age. Gestational age versus placental thickness scatter graph showed a perfect increasing linear trend with increasing gestational age and almost matching it.

Placental Grading: Among the 100 placenta in this study, 46% were grade 0, 35% grade 1, 17% grade 2, and 2% shown grade 3 maturity. All placentas to start with grade 0 and gradually progressed to grade 1 and 2, and only 2 placentae had reached grade 3 [Table 3].

Placental grades	Number of cases	%	Mean gestational age in weeks	Mean placental thickness in mm
Grade-0	46	46%	15.17	14.52
Grade-1	35	35%	29.17	28.28
Grade-2	17	17%	36.00	36.47
Grade-3	02	02%	38.50	39.50

Table 3: Results of placental grading

Among the 46 placenta of grade-0, the mean gestational age was 15.17 wks. & and the mean Placental thickness was 14.52 mm. The minimum gestational age was 10 weeks; maximum was 24 weeks. The minimum Placental thickness was 09 mm; maximum was 24 mm in this group. [Fig. 1]



Fig. 1: Ultrasound image of anterior wall placenta of 13 weeks 4 days' gestation showing placental thickness of 14 mm and grade 0 maturity

Among the 35 placenta of grade-1, the mean gestational age was 29.17 wks. and the mean placental thickness was 28.28 mm. The minimum GA was 21 weeks, maximum was 38 weeks and the minimum placental thickness was 22 mm, maximum was 38 mm in this group. [Fig. 2]



Fig. 2: Ultrasound image of anterior wall placenta of 22 weeks 5 days' gestation showing placental thickness of 22 mm and grade I maturity

Among the 17 placenta of grade -2, the mean gestational age was 36 wks. and the mean placental thickness was 36.47 mm. The minimum gestational age was 29 weeks, maximum was 39 weeks and the minimum placental thickness was 31 mm, maximum was 40 mm in this group. [Fig. 3]



Fig. 3: Ultrasound image of anterior wall placenta of 36 weeks 1-day gestation showing placental thickness of 37 mm and grade II maturity

Among the 02 placenta of grade-3, the mean gestational age was 38.50 wks. and the mean placental thickness was 39.50 mm. The minimum gestational age was 38 weeks, maximum was 39 weeks and the minimum placental thickness was 39 mm, maximum was 40 mm in this group. [Fig. 4]



Fig. 4: Ultrasound image of anterior wall placenta of 39 weeks' gestation showing placental thickness of 39 mm and grade III maturity

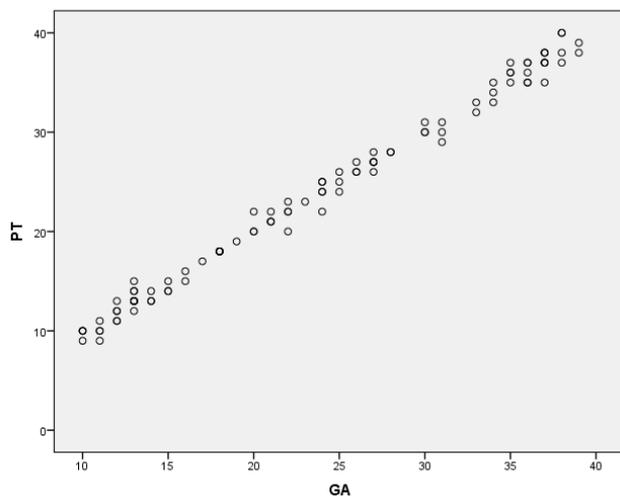


Fig-5: Scatter diagram of Placental thickness (mm) versus Gestational age (weeks)

DISCUSSION: The present study has evaluated the relationship between placental thickness in millimeters versus the foetal gestational age in weeks and placental maturity changes with advancing gestational age which helps in understanding the placental growth pattern in normal pregnancy.

Many authors have concluded that average placental thickness in millimeters is roughly equal to gestational age in weeks and found that at no stage of pregnancy was the normal placenta is greater than 40 mm in thickness. They have also reported an increasing trend in the values of mean placental thickness in mm with increase in gestational age in weeks. They have observed a linear relationship between placental thickness and gestational age and have published nomograms on placental thickness.^{4,5,6,7} Our results in this study are also consistent with observations of the previous studies. The placental thickness almost increases in a linear and direct pattern with advancing gestational age from 12 weeks till term. Hence the placental thickness can be used as a parameter of foetal gestational age assessment in normal gestations.

In this study the mean placental thickness was 11.8 mm at 12 weeks and 38.5 mm at 39 weeks of gestation. Placental thickness measurements can differentiate normal from abnormal (thick and thin) placenta noticed in several conditions. Thin placenta may be due to Intra uterine growth

retardation, placental infarction, hypertension and pre-eclampsia. Thickening of the placenta may be associated with maternal diabetes, foetal hydrops and intra uterine foetal infections.⁸

In this study we attempted to group the placenta according to their USG grading and observed progressive changes in placental maturity with advancing gestational age. We noticed 46% grade-0, 35% grade-1, 17% grade-2, and 2% grade-3 placenta. Grannum observed 33.2% grade-0, 24% grade-1, 24.8% grade-2 and 18% grade-3.⁹

According to Petrucha RA and Piatt LD, the mean gestational age at which the placenta matures to grade 1 is 31 weeks, grade 2 is 36 weeks and grade 3 is 38 weeks.³ In this study the mean gestational age was 15.17 wks for grade 0, 29.17 wks. for grade I, 36 wks. for grade II and 38.5 wks. for grade -3, which is in agreement with the above study.² Premature or delayed placental maturity should raise suspicion of certain abnormal conditions. Grading of placenta will help in exclusion of such conditions associated with abnormal maturation. Hence routine placental grading is useful in all obstetric USG examinations.

This cross sectional study was done on normal gestations of different individuals and not a true placental growth curve obtained by serial measurements taken on the same patient. It is necessary to make serial measurements in the same patient to arrive at a true placental growth curve. It is also necessary to take measurement of the placental thickness at the cord insertion site perpendicularly for the accuracy of measurements. Imaging in oblique planes, measuring at places other than cord insertion site, will all result in spurious measurements. Using excessive probe pressure over abdomen will cause placental compression and leads to false thickness calculations. Measurements of posteriorly located placenta especially in last weeks of gestation is difficult because of reduced liquor, intervening foetal parts and posterior shadowing of foetal bones. Colour Doppler will be helpful in identifying cord insertion site.

CONCLUSIONS: With our observations in this study, it showed that the placental growth pattern with advancing gestational age is linear and direct. Placental thickness in mm almost matches gestational age in weeks. Hence placental thickness can be used as an additional parameter for estimation of foetal gestational age. Placental grading also helps in understanding maturity and growth pattern and to rule out conditions associated with premature and delayed maturity. It is essential to adopt placental thickness measurement with grading in all obstetric USG examinations to rule out certain conditions associated with thick and thin placenta and abnormal placental maturation.

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