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Sonological Evaluation of gestational Age by Placental Thickness

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Abstract
Background: *Ultrasound is a non-invasive procedure used routinely in antenatal check up. gestational age is essential to manage pregnancies in regard to terminating pregnancy, managing high risk pregnancies, elective induction of labour & elective caesarean sections.*
Many fetal parameters are used sonographically to date pregnancy which includes fetal bi-parietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC) and along with that placental thickness measured at umbilical cord insertion site can also be used as a new parameter for estimating gestational age.
Present study was undertaken to evaluate the relationship between placental thickness and gestational age of the fetus and also to assess the growth pattern of placenta with advancing gestational age.
Aims and Objectives: *Estimation of gestational age of fetus by measuring placental thickness at umbilical cord insertion site*
Methods: *This is a prospective study, conducted in King George hospital, Department of Radiodiagnosis. A total of 100 pregnant women were selected between the gestational ages from 14 weeks to 40 weeks who do not have any maternal or fetal complications*
The Placental thickness (PT) is measured by e-saote ultrasound machine with a curvilinear probe 3.5 MHz. Mean value of placental thickness along with the standard deviation (SD) value and 95% confidence interval were calculated for each gestational age between 14 weeks to 40 weeks. Pearson's correlation analysis and linear regression analysis was done quantifying the relationship between the gestational age in weeks and the placental thickness in millimetres
Results: *Placental thicknessis gradually increased from 14 to 36 weeks which almost correlates with the gestational age in weeks and the placental thickness with gestational age from 37-40 weeks falls marginally.*
Interpretation: *Linear and direct relationship of placental thickness with gestational age is noticed from 14-36weeks*
After 37 weeks of period of gestation, placental thickness with gestational age falls marginally.
Conclusions: *Placental thickness can also be used as an estimate for gestational age from 14- 36 weeks.*

Introduction

Gestational age is important in false menstrual dates,

- To schedule invasive procedures such as chorionic villous sampling, amniocentesis

- To anticipate normal spontaneous delivery or to plan elective delivery at term.
- To evaluate fetal growth.

Placental evaluation by Sonography provides safe, non-invasive means to evaluate placenta with

normal and abnormal size, appearance and characterise placental position and morphological changes and detection of placental abnormalities like non immune hydrops, gestational diabetes, intrauterine growth restriction.

Several sonographically derived fetal parameters are used to date pregnancy. They are fetal crown-rump length (CRL), biparietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC). Placental thickness measurement can be used as a new parameter to estimate gestational age.

Objectives of the Study
Aim
Evaluating placental thickness, by measuring at umbilical cord insertion site.

i. for estimating gestational age of the fetus.

ii. assessing placental growth with advanced gestational age

Materials and Methods
SOURCE OF DATA: 100 antenatal women attending antenatal clinic at King George Hospital, Vizag were included in the study

Inclusion Criteria
Antenatal women of all gestational ages from 14 weeks to 40 weeks of gestation who do not have any fetal/ maternal comorbidities attending to Department of Radiodiagnosis, Andhra Medical College, vizag for routine antenatal ultrasound were included in the study

Exclusion Criteria
1) Patients with pregnancy induced hypertension, diabetes mellitus, IUGR, hydrops fetalis, congenital malformations, twins, Polyhydraminos, Oligohydraminos
2) morphological variations in size and shape of placenta like lobed placenta, succenturiate lobe, placental membranacea and circumvillate placentas.
3) Placenta with variations in insertions of umbilical cord like marginal or battledore placentas and velamentous cord insertions.
4) Placentas with poor cord insertion site visualization.
5) Poor sonographic visualization of the placenta: Due to maternal obesity and posterior shadowing from feta structures.

Scanners and transducers
The grey scale real time ultrasonographic examinations were performed using an e-saotemachine. The transducer used is 3.5MHz convex array transducer.

Procedure
The patient was asked to lie in supine position and scanned by placing transducer on skin surface after applying coupling agent. placental thickness, in mm, was measured at cord insertion site. The transducer was oriented perpendicularly to both chorionic and basal plates and Placental thickness was measured by placing the callipers from echogenic chorionic plate to placental myometrial interface. myometrium and subplacental veins were excluded while measuring. placental measurements should be taken in relaxed phase of the uterus as contractions can spuriously increase the placental thickness. Taking the average of the best three measurements for each case placental thickness in mm was calculated. Cases are then categorized, basing on placental location into: Anterior, posterior, fundal, lateral. Mean placental thickness, Standard deviation, 95 % confidence interval of mean from 14 weeks to 40 weeks is obtained in each group separately.

Images

Results

Age distribution of antenatal women studied:

Table-1

AGE GROUP	NO OF CASES	% OF CASES
< 21 YEARS	10	10
21-25 YEARS	53	53
26-30 YEARS	22	22
>30 YEARS	15	15
TOTAL	100	100

Most of antenatal women are in the age group between 21 -25 years

Distribution of placental position

Out of 100 cases, anterior placenta was noted in 33 cases, posterior 48 cases, fundal and lateral in 9 and 10 cases respectively.

Table-2

PLACENTA LOCATION	NO OF CASES	% OF CASES
ANTERIOR	33	33
POSTERIOR	48	48
FUNDAL	9	9
LATERAL	10	10

Relationship between gestational age and placental thickness

Table-3

GESTATIONAL AGE (WEEKS)	NO OF CASES	PLACENTA THICKNESS (MM) (MEAN)	PLACENTA THICKNESS (SD)	95% CI OF MEAN
14	2	14.5	0.424	13.912-15.088
15	3	15.46	0.353	15.06-15.86
16	3	16.366	0.450	15.86-16.86
17	4	17.425	0.411	16.895-17.95
18	4	19	0.469	18.54-19.46
19	3	19.433	0.450	18.9-19.94
20	7	20.342	0.431	20.023-20.662
21	4	22	0.432	21.577-22.423
22	3	22.33	0.351	21.933-22.727
23	4	23.615	1.560	21.086-24.144
24	3	24.5	0.435	24.007-24.993
25	2	25.55	0.494	24.814-26.186
26	2	26.9	0.141	26.704-27.096
27	3	28.0667	0.251	27.781-28.351
28	3	28.133	0.611	27.442-28.824
29	4	29.65	0.655	29.007-30.293
30	4	30.075	0.73	30.234-30.687
31	7	31.4	0.66	30.91-31.89
32	6	32.0166	0.699	31.456-32.576
33	6	33.0833	0.688	32.532-33.634
34	4	33.8	0.668	33.145-34.455
35	3	35.466	0.3511	35.069-35.863
36	3	35.833	0.152	35.66-36.006
37	3	35.5	0.435	35.007-35.993
38	4	36.525	0.736	35.803-37.247
39	4	36.625	0.434	36.199-37.051
40	2	38.55	0.353	38.06-39.04

Results

The placental thickness (in mm) almost correlated to gestational age with linear regression model from 14 to 36 weeks. Thereafter the placental thickness marginally decreased from 37 to 40 weeks

Accurate prediction of gestational age from placental thickness by 95% confidence interval is observed.

The placental thickness did not vary with placental location

Pearson Correlation Analysis Showing Relationship between Placental Thickness and Gestational Age

Weeks	No. of Cases	Correlation Coefficient
14-20	26	0.98
21-25	16	0.94
26-30	16	0.89
31-36	26	0.92
37-40	16	0.77

Linear Regression Analysis for Predicting Gestational age based on Placental Thickness

Regression Analysis for 14 – 36 weeks

Summary Output	
Regression Statistics	
Multiple R	0.99672146
R Square	0.99345368
Adjusted R Square	0.99337666
Standard Error	0.53496379
Observations	87

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3691.62819	3691.62819	12899.3901	1.3099E-94
Residual	85	24.3258319	0.28618626		
Total	86	3715.95402			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.9327158	0.24092403	-3.8714104	0.00021174	-1.4117373	-0.4536943	-1.4117373	-0.4536943
Thickness(mm)	1.02014855	0.00898212	113.575482	1.3099E-94	1.00228969	1.0380074	1.00228969	1.0380074

We can see the adjusted R square is 0.99 which shows the analysis performed is correct and the p value i.e., 0.00021 shows that the hypothesis is correct which is the gestational age is correlated with the placenta thickness.

The equation from which the gestational age can be known through thickness is shown as below

Y <Gestational Age> = 1.02 * Placenta Thickness – 0.933

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	8.74822244	8.7482244	22.2307928	0.0006346
Residual	11	4.3287 0064	0.39 351824		
Total	12	13.076 9231			

Regression Analysis for 37 _ 40 weeks

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.81791302
R Square	0.66898172
Adjusted R Square	0.63888914
Standard Error	0.62731032
Observations	13

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9.37414516	6.15532307	1.52293309	0.15599252	4.1736296	22.9219199	4.1736296	22.9219199
X Variable 1	0.79197	0.16796982	4.71495416	0.0006346	0.42227092	1.16166908	0.42227092	1.16166908

From this analysis we can see that the p value is more than 0.05 hence the hypothesis whatever taken before prove to be inaccurate for this gestation period of 37-40 weeks.

Discussion

Ultrasonogram was found to be highly accurate in placenta localization. placenta was evaluated previously for its position or to ascertain premature separation. A more detailed evaluation of the placenta by ultrasonogram led to understanding of morphologic changes as placenta matures placental thickness is a function of age. Abnormal thickening or thinning should be correlated with duration of pregnancy .The present study assessed relationship of placenta thickness (in mm) with s gestational age (in weeks) and also the growth pattern with advancing gestational age. The study showed that the placental thickness (in mm) increases linearly with increasing gestational age and almost matching the gestational age from 14-36 weeks of gestation. The rate of increase of placental thickness is gradually diminished from 37-40 weeks The results of the present study are in concordance with the observations of previous studies.

Hoddick et al (1985) found average placental thickness (in mm) to be roughly equivalent to gestational age (in weeks).

Mital P and Hooja N found an increasing trend in values of mean placental thickness (in mm) with increase in gestational age (in weeks) and placental thickness (in mm) coincides almost exactly with gestational age in weeks.

.Anupama et al[9] reported similar correlation between placental thickness and gestational age. They found placental thickness (in mm) almost correlated with gestational age (in weeks) from 27 weeks to 33 weeks of gestation.

Grannum et al[12] reported placental thickness increases linearly till 33 weeks of pregnancy, after which there was gradual thinning.23 Other authors reported similar findings. Berkowitz et al reported decrease in placental size after 32 weeks until term.

C.C.Ohagwu, P.O. Abu et al[11] reported that placental thickness had strong positive correlation with BPD and AC; both parameters having identical association with placental thickness.

Rate of growth of placental thickness did not vary relative to placental location as observed in present study. Similar observations are made by Hoddick et al (1985)

Significance of placental size

Placental thickness changes are an expression of normal growth of the fetoplacental unit amenable for measurement with USG and of value in describing normal physiology.

Fetal abnormalities detected through measuring placentalthickness. Thin placenta is noted in small for dates fetuses, pre-eclampsia, chromosomal abnormalities and severe intra –uterine infection. Thick placentas are noted in hydrops fetalis, diabetes mellitus and intrauterine infections. Sonographically thick placenta is associated with increased perinatal mortality from fetal anomalies.

Accuracy of placental thickness measurements

To obtain an accurate placental measurement, it is important to identify placental-myometrial interface. When placenta is posterior, identifying the region is facilitated by acquisition of images as free from acoustic shadowing from the fetus. When placenta is anterior, proper transducer position and gain settings are required in minimizing near field and reverberation artifacts. identification of the placental-myometrial interface should be correctly made to preclude the illusion of placental thickening induced by focal myometrial thickening. Placental thickness appears focally increased in uterine contractions or myomata.

Limitations of the study

It is a cross sectional study, made up of observations on different individuals. It is not a true placental growth curve which is obtained by taking serial measurements on same patient throughout the gestation. So, it does not provide clear understanding in individual growth patterns. However, it is a reasonable approximation of a true placental growth curve.

Accuracy of placental measurements depends on making a perpendicular scan of the placenta and

interpretating the images to prevent spurious measurements. Images should be acquired at cord insertion site. All the 100 cases were examined using the same equipment and by the same examiner to minimize the measuring errors

-placental thickness vary among different population groups. Population specific monograms may be needed to derive from large sample sizes. The placental growth curves vary with different population groups.

Cord insertion site on the placenta in posterior locations was difficult to image in normal term Pregnancies.

Conclusions

1) Linear and direct relationship between the placental thickness and gestational age is observed from 14 -36 weeks.

2) Placental thickness (in mm) increase with increasing gestational age (in weeks) and almost matching it from 14 to 36 weeks of gestation.

3) Placental thickness from 37- 40 weeks of gestational age falls marginally

4) The placental thickness and growth pattern did not vary with placental location.

5) Correlation of placental thickness with gestational age should facilitate the detection of abnormal placental thickness associated with IUGR, hydrops fetalis and diabetes mellitus

Summary

Sonographic measurement of placental thickness, at the level of umbilical cord insertion site is simple and clinically useful. It enables to evaluate and detect placental abnormalities which affects the management and outcome of pregnancy.

Placental thickness (in mm) increases in a linear fashion with increasing gestational age (in weeks) and almost matches from 14-36 weeks of gestation. It is used as an additional parameter in gestational age estimation where the duration of pregnancy is uncertain

It was observed from the present study, that there is marginal decrease in placental thickness after 36 weeks of gestation.

Determining placental thickness is useful in diagnosing abnormalities; a thin placenta seen in IUGR and thick placentas noted in hydrops fetalis of varied causes

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