Ultrasonographic Placental Thickness - Its Correlation to Gestational Age

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Abstract: _Introduction: Placental growth and maturation with advancing pregnancy is essential for the healthy growth and development of foetus and a correlation between physical measurement of placenta and gestational age is not a very illogical expectation.The present study was undertaken with a view to find out if a correlation exists between gestational age and placental thickness. Aims and Objectives: 1) To study the correlation between placental thickness and gestational age of foetus. 2) To determine normal ultrasonographical placental thickness for various gestational ages. Material and Methods: It was an observational study done at the Deptt. of Obstetrics & Gynaecology, Dr. S. N. Medical College Jodhpur, Rajasthan. About 333 antenatal mothers with varying gestational ages from 11-40 weeks with known LMP, inclusion criteria satisfied & exclusion criteria verified were subjected to ultrasonographic examination. After estimating the fetal age by CRL, BPD, HC, AC and FLplacental thickness is measured for mothers whose fetal biometrycorresponds to LMP and the clinically assessed gestational age. Results: The mean values of placental thickness were calculated for differentgestational ages from 11 – 40 weeks. It was observed that placentalthickness gradually increased from 14.6mm at 11 weeks to 38.9mm at 40weeks gestation. In our study, the mean placental thickness was slightly in the higherrange for the corresponding gestational age upto 19 weeks. From 20weeks to 36 weeks of gestation the placental thickness in mm almostmatched with corresponding gestational age in weeks. After 36 weeks,placental thickness started decreasing by 0.5 to 1mm to correspondinggestational age till 40 weeks. Conclusions: The measurement of placental thickness is an important parameter for estimation of fetal age. It is helpful in cases where the exact duration of pregnancy is not known, where the placental thickness almost matches with gestational age. It can also be used in low resource setting like a public health centre with minimal training. Measurement of placental thickness during obstetric ultrasound can be made as a routine practice. Including placental thickness into routine fetal biometry might improve pregnancy dating and might also minimize the discrepancy even late in second and third trimester. If the placental thickness is abnormal, causes for abnormal placental thickness should be borne in mind and carefully searched for._

Keywords: Ultrasonography, placental thickness, gestational age

1. Introduction

Gestational age is the most important criteria in decisionmaking in managing high risk pregnancies. Correct estimation of gestational age lies on the relevant menstrual history, first trimester pelvic examination, date of quickening and first trimester USG parameters.

Unfortunately, approximately 50% of women are unable to recalltheir LMP[1]. In cases of ART successful pregnancies, the date of embryotransfer can be used for calculating EDD.

It was Sir Naegele, a German obstetrician who first commented onthe average duration of pregnancy and according to Naegele's rule, inwomen who regularly ovulate and menstruate every 28 days the meanduration of pregnancy is 280 days or 40 weeks from the last menstrualperiod and the expected date of delivery is calculated by adding 1 year and 7 days and counting back 3 months from the date of LMP.

Naegele's rule cannot be applied for unreliable cycles with irregularmenstrual histories.Only 4% of women deliver on EDDcalculated by the Naegele's rule. Mat Su moto et al reported approx.. 20% of population have early or late ovulation[2]. In that case, Parikh formula is applied,Parikh formula-Add 9 months to LMP, subtract 21 days from it andthen add the duration of the previous cycles[3]. Ultrasound has revolutionized modern obstetric practice and has become the standard tool of assessing gestational age.

This study was undertaken to evaluate the reliability of placentalthickness as a parameter to estimate gestational age.

Aims and Objectives
1) To study the correlation between placental thickness and gestational age of foetus.
2) To determine normal ultrasonographical placental thickness for various gestational ages.

2. Material and Methods

It was an observational studydone at the Deptt. of Obstetrics & Gynaecology, Dr. S. N. Medical College Jodhpur, Rajasthan. About 333 antenatal mothers of different gestational ages attending the OPD were studied for their placental thickness. Each patient was scanned once during the study.

Inclusion criteria
1) Antenatal mothers of gestational age (11-40weeks) attending OPD.
2) Antenatal mothers with LMP known.
3) Singleton pregnancy.

Exclusion Criteria
1) Consent not given.
2) Irregular periods.
3) LMP not known.
4) Polyhydramnios.
5) Diabetes mellitus.
6) Hypertensive disorders of pregnancy.
7) Heart disease complicating pregnancy.
8) Anemia complicating pregnancy.
9) Jaundice complicating pregnancy.
10) Renal disease.
11) Diagnosed Intrauterine growth restriction.
12) Hydrops fetalis.
13) Multiple pregnancy.
14) Fetal anomalies.
15) Placental anomalies.

3. Examination Methods

- Consent for doing ultrasound and their co-operation for my studywas taken.
- A thorough history regarding medical illness & obstetric history istaken for each patient.
- Symphysio– fundal height was measured after emptying thebladder. Fundal height by palpation and gestational age wasclinically assessed.

These antenatal mothers with known LMP, Inclusion criteriasatisfied & exclusion criteria verified are subjected to ultrasonographicexamination. After estimating the fetal age by CRL, BPD, HC, AC and FL, placental thickness is measured for mothers whose fetal biometrycorresponds to LMP and the clinically assessed gestational age.

Ultrasonographic examination was performed in the department of Radiology. Transabdominal sonographic examination was performedusing a 3.5 MHz convex probe. This scan was performed with optimal bladder with the mother in the supine position.The sonographer must maintain a perpendicular measurement of the placental surface in relation to the myometrial wall when evaluating the thickness of the placenta[4].The ultrasound gestation age is calculated by measuring CRL (11-13 weeks), BPD, AC, FL, HC (14-40 weeks). Placental thickness is measured in millimetres at the level of umbilical cord insertion in itslongitudinal direction and the mean of 3 readings will be taken.

Statistical Tools
The information collected regarding all the selected cases wererecorded in a Master Chart in Excel sheet. The data were processed in the statistical package for social sciences software for Windows version 12. Using this software range, frequencies, percentages, means, standard deviations, 'F' value and 'p' values were calculated. For qualitative variables chi square test was used. A 'p' value less than 0.05 will denotesignificant relationship. Regression analysis was done for estimation ofgestational age with the help of other variables.For preparing the diagrammatic representations, Power pointsoftware was used.

4. Results and Analysis

In our study a total of 333 antenatal mothers were studied. Alongwith routine fetal biometry like CRL, BPD, HC, AC and FL, placental thickness was also measured for these antenatal mothers. The results were analysed with the regard to the gestational age, placental thickness, location of placenta and fetal biometry like BPD, FL, HC and AC. The mean value of placental thickness along with the respective standard deviation was calculated for gestational age from 11-40 weeks.The correlation between placental thickness and gestational age was analysed using Pearson's correlation. Correlation between placentalthickness and other fetal parameters like BPD, FL, HC and AC was analysed using Pearson's correlation. Association between Placental Thickness and Placental location ineach trimester calculated using Student's 't' test. Association between Placental Thickness with Gestational age andfetal biometry parameters calculated using Student's 't' test.

Table 1: Cases as per age distribution

Age	No. of cases	%age of total cases (333)
Below 20 years	8	2.4 %
20-24 years	101	30.3 %
25-29 years	136	40.8 %
30-34 years	74	22.2 %
35 years and above	14	4.2 %
Total	333	100.0 %

There were total of 333 antenatal women. Age distribution ranged from 18years to 40 years. There were 8 cases below 20 years, 101 casesbetween 20 -24 years, 136 cases between 25-29 years, 74 cases between30-34 years, 14 cases above 35 years.

Table 2: Cases as per Parity

Parity	No. of cases	%age of total cases (333)
Primi gravida	149	44.7 %
Multi gravida	184	55.3 %
Total	333	100.0 %

Among the total 333 antenatal women 149 were primigravida and 184 were multi gravida as evident from the table.

Table 3: Cases as per Gestational age

Gestational Age	No. of cases	%age of total cases (333)
Up to 13 weeks + 6 days	15	4.5 %
14-27 weeks + 6 days	145	43.5 %
28 weeks and above	173	52.0 %
Total	*333*	*100.0 %*

About 333 antenatal women with varying gestational ages from 11-40 weeks were included in the study. There were 15 women in the firsttrimester, 145 women in second trimester and 173 women in thirdtrimester.

Table 4: Cases as per Placental location

Placental location	No. of cases	%age of total cases (333)
Anterior	155	46.5 %
Posterior	155	46.5 %
Lateral	12	3.6 %
Fundal	11	3.4 %
Total	333	100.0 %

Table 5: Cases as per Placental location and Thickness in each Trimester

Placental location	First trimester			Second trimester			Third trimester		
	No. of cases	Mean	SD	No. of cases	Mean	SD	No. of cases	Mean	SD
Anterior	9	14.86	0.75	67	22.83	2.67	79	32.97	3.07
Posterior	4	14.5	0.32	70	22.71	2.95	81	33.19	2.63
Lateral	1	15.2	-	1	24.3	-	10	33.71	3.86
Fundal	1	16.0	-	7	22.77	3.96	3	31.67	0.25
Total	15	14.86	0.69	145	22.78	2.85	173	33.09	2.89
'p'	0.2707 Not significant			0.9508 Not significant			0.7035 Not significant		

Association between Placental Thickness and Placental location was calculated using Student's `t test. Placental location in each trimester was correlated with placentalthickness for each trimester and found that the placental location does notaffect the placental thickness. 'p' value in first trimester is 0.2707, 'p'value for second trimester is 0.9508 and 'p' value for third trimester is 0.7035 not significant.

Table 6: Cases as per Birth weight in kg

Birth weight (kg)	No. of cases	%age of total cases (315)
< 2 kg	0	0.0 %
2-2.49 kg	7	2.2 %
2.5-2.99 kg	148	47.0 %
3-3.49 kg	143	45.4 %
>3.5 kg	17	5.4 %
Total	315	100 %

Table 7: Cases w.r.t. Placental thickness versus Gestational age in weeks

S. No.	Gestational age (weeks)	No. of cases	Placental thickness (mm) Mean	Standard deviation
1	11	6	14.6	0.34
2	12	6	14.9	0.93
3	13	3	15.3	0.61
4	14	3	16.1	0.45
5	15	2	16.9	0.57
6	16	1	16.7	0.0
7	17	2	17.5	1.06
8	18	4	19.0	0.5
9	19	5	20.2	0.6
10	20	18	20.4	0.88
11	21	23	21.5	0.66
12	22	23	22.9	1.1
13	23	19	23.3	1.41
14	24	10	23.9	0.85
15	25	13	25.1	0.95
16	26	9	26.9	1.02
17	27	13	27.3	1.38
18	28	14	28.3	0.97
19	29	14	30.2	0.75
20	30	15	31.0	1.21
21	31	16	30.6	0.98
22	32	24	32.1	0.65
23	33	16	33.2	0.74
24	34	15	33.8	0.92
25	35	23	35.1	0.83
26	36	12	35.9	0.51
27	37	8	36.6	0.59
28	38	9	37.7	0.4
29	39	4	38.5	0.31
30	40	3	38.9	0.2

Placental thickness had a linear relationship with gestational age. Asgestational age increases placental thickness also increases.Mean placental thickness for gestational ages 11 to 40 weekscalculated and it is evident that placental thickness increases as gestational age increases.

Table 8: Cases w.r.t. placental thickness versus fetal biometry

S. No.	Gestational age (weeks)	Mean placental thickness (mm)	Mean BPD (mm)	Mean Fetal length (mm)	Mean Head Circumference (mm)
1	11	14.6	-	-	-
2	12	14.9	-	-	-
3	13	15.3	-	-	-
4	14	16.1	27.8	15.0	98
5	15	16.9	30.7	18.5	114
6	16	16.7	28.4	22.1	119
7	17	17.5	41.1	25.9	136
8	18	19.0	42.3	29.3	153
9	19	20.2	43.9	31.4	160
10	20	20.4	46.8	34.8	173
11	21	21.5	49.7	36.0	186
12	22	22.9	52.8	37.4	193
13	23	23.3	57.5	42.1	212
14	24	23.9	60.1	41.9	219
15	25	25.1	64.0	48.4	233
16	26	26.9	66.3	46.2	245
17	27	27.3	68.8	50.1	256
18	28	28.3	71.1	53.8	260
19	29	30.2	74.9	57.4	270
20	30	31.0	77.2	58.7	282
21	31	30.6	76.7	58.0	291
22	32	32.1	80.1	63.3	296
23	33	33.2	83.6	65.0	308
24	34	33.8	84.2	66.1	311
25	35	35.1	83.0	66.6	324
26	36	35.9	89.5	69.8	330
27	37	36.6	89.0	69.1	329
28	38	37.7	92.7	71.7	339
29	39	38.5	94.2	74.7	340
30	40	38.9	94.3	76.1	341

Table 8: Correlation between placental thickness and other variables

Variable	Correlation coefficient (r2) with placental thickness	'p'
Gestational age	0.98	<0.0001 Significant
BPD	0.93	<0.0001 Significant
Fetal length	0.92	<0.0001 Significant
AC	0.91	<0.0001 Significant
HC	0.22	<0.0001 Significant
CRL	0.35	0.0215 Significant

Pearson's correlation coefficient was used to assess the correlationand Student's 't' test used to test the significance of association between Placental thickness and other variables. There is a significant positive correlation between placental thickness and gestational age. Correlation coefficient is 0.98 and 'p' value<0.0001. There is a significant positive correlation of placental thickness with other fetal biometry parameters like BPD, FL, AC, HC and CRL. Correlation coefficients are BPD{0.93}, FL{0.92}, AC{0.91}, HC{0.22}, and CRL{0.35}. P value is< 0.0001 for BPD,FL,AC and HC. 'P' value for CRL is 0.0215.

Table 10
Regression Equations for estimation of Gestational Age
a) Gestational Age = 1.061 x Placental Thickness - 1.749
b) Gestational Age = 0.037 x BPD + 2.654
c) Gestational Age = 0.042 x FL + 6.366
d) Gestational Age = 0.094 x AC + 5.838
e) Gestational Age = 0.031 x HC + 20.174
f) Gestational Age = 1.103 x CRL + 5.854
Univariate analysis was done.

5. Discussions

In our study a total of 333 antenatal women of different gestationalages were studied for their placental thickness.The mean values of placental thickness was calculated for differentgestational ages from 11 – 40 weeks. It was observed that placentalthickness gradually increased from 14.6mm at 11 weeks to 38.9mm at 40weeks gestation.

In our study, the mean placental thickness was slightly in the higherrange for the corresponding gestational age upto 19 weeks. From 20weeks to 36 weeks of gestation the placental thickness in mm almostmatched with corresponding gestational age in weeks. After 36 weeks,placental thickness started decreasing by 0.5 to 1mm to correspondinggestational age till 40 weeks.In our study there is a significant correlation between placentalthickness and gestational age, assessed by Pearson correlation, thecorrelation coefficient is 0.98 and p value <0.0001.

Correlation between placental thickness and other fetal biometrylike BPD, FL,AC and HC done using Pearson correlation.In our study placental thickness almost had a positive correlationwith other fetal biometry like BPD and FL. Correlation coefficient being0.93 and 0.92 respectively with p value <0.0001 for both.In our study the correlation coefficient for AC and placentalthickness is 0.91 and p value<0.0001. Correlation coefficient for HC andplacental thickness is 0.22 and p value<0.0001.

Regression equation was calculated to measure gestational age withplacental thickness as follows GA =1.061Å~PT-1.749.

In our study the differences in placental thickness with regard to thelocation was analysed for each trimester. Association between placentalthickness and placental location was done using student's `t' test. There was no significant relationship between placental thickness and placental location. 'p' value for first trimester is 0.2707, second trimester is 0.9508 and third trimester is 0.7035 which are not significant.

6. Conclusions

From the above discussion it is evident that there is a significantcorrelation between placental thickness and gestational age. It appears that placental thickness can be reliably used to estimate gestational ageimportantly for mothers whose clinical history is not reliable, who comefor antenatal booking in the second half of pregnancy and in conditionswhere BPD measurements become less reliable. The present study has shown a significant correlation between the placental thickness and gestational age from 20 to 36 weeks.

Uses of Placental Ultrasonography
a) To determine gestational age in late second orthird trimester when exact duration of pregnancy is not known.
b) As a predictor for LBW[5-8]
c) Prognostic value in identifying subsequent occurrence ofIUGR[9-10]
d) Placental thickness at mid pregnancy (18 -21 weeks) as apredictor of Hb Barts disease there by reducing the number ofinvasive diagnostic procedures[11,12]
e) Placental volume measurement is used in predicting LBW, chromosomal anomalies, Abnormal Doppler and first trimesterscreening[13-15].

The measurement of placental thickness is an important parameter for estimation of fetal age. It is helpful in cases where the exact duration of pregnancy is not known, where the placental thickness almost matches with gestational age. It can also be used in low resource setting like a public health centre with minimal training. Measurement of placental thickness during obstetric ultrasound can be made as a routine practice. Including placental thickness into routine fetal biometry might improve pregnancy dating and might also minimize the discrepancy even late in second and third trimester. If the placental thickness is abnormal, causes for abnormal placental thickness should be evaluated further.

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