Original Article

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Radiology Section

Placental Thickness & its Correlation to Gestational Age & Foetal Growth Parameters- A Cross Sectional Ultrasonographic Study

T KARTHIKEYAN, RAMESH KUMAR SUBRAMANIAM, WMS JOHNSON, PRABHU K

ABSTRACT

Background: The Gestational Age (GA) is frequently over or under estimated, as the conventional gestational estimation is based on the Last Menstrual Period (LMP) and on ultrasonography (USG). Many people are unaware of their LMP and irregular menstruations and USG is bound to have a bias, thereby posing difficulties in the GA estimation.

Aim: This study was aimed at estimating the (Placental Thickness) PT and at investigating the relationship between PT and the foetal growth parameters in normal singleton pregnancies.

Materials and Methods: Two hundred eleven pregnant women were recruited in a cross sectional prospective study. The pregnancies were between 11 to 40 weeks and they were not complicated by either maternal or foetal diseases. The Biparietal Diameter (BPD), the Abdominal Circumference (AC), the Head Circumference (HC), the Femur Length (FL) and the PT were measured by USG by using a 3.5 MHz transducer.

Results: The maximum mean PT in the 1st, 2nd, 3rd and the combined trimesters were 16.5 mm, 23.78 mm, 35.81 mm and 28.49 mm respectively. The correlation between PT and the other foetal parameters was investigated by Pearson's correlation analysis. The values were expressed as mean + standard deviation. The statistical tests were two-tailed, with a p value of < 0.01, which indicated the statistical significance. There was a strong positive correlation between PT and GA, with the correlation coefficient values for the 1st, 2nd and 3rd trimesters being $r = 0.609$, $r = 0.812$ and $r = 0.814$ respectively. There was a significant positive correlation between PT and BPD, AC, FL, ABC, HC and FW also. The mathematical relationships between PT and GA, BPD, AC, FL, ABC, HC, FW were derived by regression analysis. The regression equation which was derived was $(x - 22.92) = (0.3604)(w-27.86446) + (1.0256)(y-1.1678) + (0.0015)(z-216.2841) + (0.1047)(t-43.1555) + (0.027)(u.192.79000) + (0.0042)(v-60.3725)$, where x = GA in weeks, w = PT in mm, y = FW in kg, z = HC in mm, t = FL in mm, u = AC in mm and v = BPD in mm.

Conclusion: We conclude that PT can be used as a predictor of the GA. The subnormal PT for the corresponding GA should be evaluated for any disease condition. So, the measurement of PT should therefore be carried out routinely during the obstetric USGs.

Key Words: Gestational age, Placental thickness, Ultrasonography, Last menstrual period

INTRODUCTION

The best possible ante partum care and the successful deliveries of babies always revolve around the accurate knowledge of the Gestational Age (GA). The gestational age is of utmost importance in the interpretation of biochemical tests such as the screening for the expanded maternal serum biomarkers (Human Chorionic Gonadrotrophin, Alfa Foeto protein and the oestrogen and progestrone levels) for the risk assessment of various foetal anomalies, in evaluating the foetal growth by distinguishing the normal from the pathological foetal development.

This allows obstetrician to institute measures that will optimize the foetal outcome [1]. When an anomaly is detected, the interventional modality which is used, is influenced by the gestational age. Virtually, all the important clinical decisions, which include caesarean section, elective labour induction, etc, depend on the knowledge of the gestational age. The gestational age is approximately 280 days, which is calculated from the first day of the last menstrual period and so, the dating of the pregnancy starts even before the fertilization. The determination of the gestational age is a common clinical problem. Ultrasonography (USG) is commonly used to estimate the gestational age by measuring the foetal dimensions like the Biparietal Diameter (BPD), the Abdominal Circumference (AC), the Head Circumference (HC) and the Femur Length (FL). An ultrasonograph is prone to observer bias, as it depends on the observers' technical skills. Also, the foetal parameters, the different techniques of measurement and the positional problems may diminish the accuracy of the gestational age estimation [2]. Wolfson et al., showed that the biparietal diameter was not reliable in the foetuses which had a premature rupture of the membranes [3]. There are some drawbacks in those above said parameters in estimating the gestational age. So, there is a need of another parameter for supplementing the gestational age estimation with minimal error. Nyberg and Finberg reported that the placental thickness parallels the gestational age [4].

MATERIALS AND METHODS

The present study was a prospective cross sectional study which was done on 211 antenatal people who were referred for USG after ruling out maternal diseases. The ultrasonography machine

which was used was Volusen E8 ex BT 08, with the use of a 3.5 MHz convex array transducer. Each foetus was measured only once during the whole study.

The inclusion criteria were as follows

1. Singleton pregnancies, 11-40 weeks
2. The known last menstrual period.
3. A history of regular menstruation.

The exclusion criteria were as follows

1. Maternal Disease
   a. Gestational Diabetes.
   b. Hypertension (Systemic hypertension and Pregnancy induced hypertension)
   c. Anaemia
2. Foetal anomalies.
3. Palcenta previa, placental anomalies and poor visualization of the placenta
4. Multiple pregnancies.
5. Last menstrual period not known or irregular menstrual periods.

A transabdominal scanner (3.5 MHz transducer) was used to determine the foetal anomalies if there was any. The gestation age was determined by measuring the biparietal diameter, the abdominal circumference, the crown rump length, the head circumference and the femur length. The placental thickness was measured at the level of the umbilical cord insertion; the maximum thickness was noted in the cross section. Each placenta was measured to a 1 mm precision, at its greatest thickness, which was perpendicular to the uterine wall. The uterine myometrium and the retroplacental veins were excluded. The subjects were in the supine position with a full urinary bladder while they underwent the ultrasonography.

The statistical analysis was performed by using SPSS 17and Excel 2007.

The ethical committee clearance was obtained from Sree Balaji Medical College and Hospital, Bharat University, Chennai, India. An informed consent was obtained from the subjects before starting with the study.

RESULTS

From the [Table/Fig-1& 2], it is clear that the placental thickness increases with the gestational age and that the placental thickness is a gestational age dependant variable. In the first trimester (12 – 13 weeks), 2nd trimester (14-26 weeks) and the 3rd trimester (27 – 40 weeks) of sample sizes 32, 89 and 90 respectively, there was an incremental placental thickness with the gestational age.

The placental thickness increases by more than 2mm in a week in the first trimester. From the 15th to the 20th week, the placental thickness increased by more than 4 mm and from the 20th to the 25th week, it increased by more than 5mm. Between the 19th to the 20th week, the placental thickness decreased by 0.85 mm. Between the 22nd to the 23rd week, the placental thickness decreased by 0.97mm.The placental thickness increases by more than 2 mm in a week in the first trimester. Between the 28th to the 29th week, the placental thickness decreased by 3.5mm, but then,

Gestation age in weeks	Sample Subjects (n)	Mean with standard deviation
12	18	15.16 ± 0.5
13	14	17.84 ± 0.79
14	6	18 ± 0.46
15	5	18.28 ± 0.77
16	4	21.95 ± 1.60
17	2	21.65 ± 6.98
18	2	23.6 ± 8.89
19	2	23.25 ± 3.81
20	11	22.4 ± 1.15
21	24	23.7 ± 0.88
22	15	25.64 ± 1.15
23	8	24.57 ± 1.77
24	4	26.62 ± 2.99
25	3	27.73 ± 0.62
26	3	31.73 ± 0.57

[Table/Fig-1]: Mean values of placental thickness in 1st trimester-12 &13 weeks (32 subjects) 2nd trimester 14-26 weeks (89 subjects)

Gestation age in weeks	Sample subjects(n)	Mean with standard deviation
27	2	30.3 ± 3.81
28	3	33.61 ± 0.24
29	3	30.03 ± 0.62
30	3	36.06 ± 0.51
31	5	35.12 ± 0.31
32	8	34.13 ± 0.81
33	18	34.75 ± 0.51
34	14	35.55 ± 0.78
35	15	34.99 ± 0.65
36	4	37.6 ± 2.04
37	3	39.33 ± 6.13
38	3	40.06 ± 4.58
39	6	39.64 ± 1.29
40	3	40.2 ± 1.38
All trimester	211	28.49 ± 1.03

[Table/Fig-2]: Mean values of placental thickness in 3rd trimester 27- 40 weeks (90 subjects)& in total samples (211)

Trimester	Sample size	Correlation between placental thickness & gestational age	P value (1 tailed test)
First Trimester	32	0.609	0.000<0.001
Second Trimester	89	0.812	0.000<0.001
Third Trimester	90	0.814	0.000<0.001

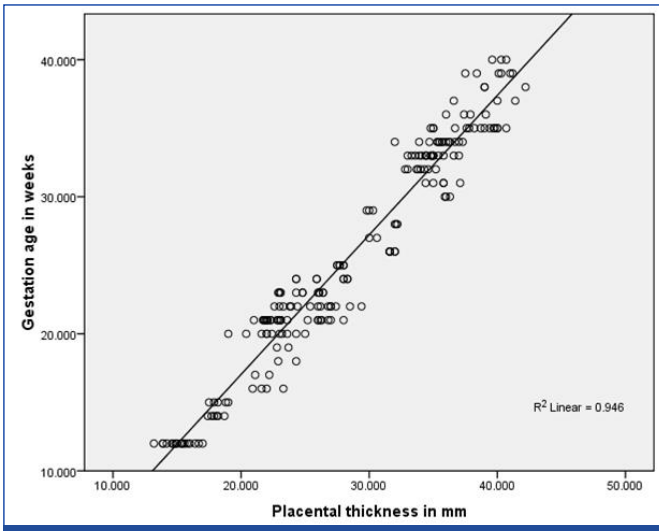
[Table/Fig-3]: t-Test Results for Three Trimesters for Correlation Coefficient

the placental thickness increases with the gestational age with out much decrescendo. The maximum placental thickness was 42.2 mm at 38 weeks and the minimum was 13.9 at 12 weeks. The average placental thickness was 28.4924mm ± (1.03) for all the trimesters.

To prove that there was a correlation the between placental thickness and the gestational age, the correlation coefficient was calcu-

	w(PT)	y(FW)	z(HC)	t(FL)	u(AC)	v(BPD)	x(GA)
w(PT)	1	0.902	0.926	0.935	0.946	0.914	0.968
y(FW)	0.902	1	0.889	0.913	0.916	0.900	0.931
z(HC)	0.926	0.889	1	0.955	0.954	0.948	0.954
t(FL)	0.935	0.913	0.955	1	0.967	0.967	0.972
u(AC)	0.946	0.916	0.954	0.967	1	0.955	0.949
v(BPD)	0.914	0.900	0.948	0.967	0.955	1	0.972
x(GA)	0.968	0.931	0.954	0.972	0.949	0.972	1

[Table/Fig-4]: Correlation matrix showing the correlation coefficient values between PT, GA, FW, HC, FL, AC, and BPD



[Table/Fig-5]: Shows correlation values distribution between PT & GA in 211 subjects.

lated and it was found to be r= 0.609, r= 0.812 and r= 0.814 for the 1st, 2nd and the 3rd trimesters respectively and the "p" value was < 0.001, thereby establishing a positive correlation between the 2 variables, as has been depicted in [Table/Fig-3]. There are some studies on the correlation between PT and 1 to 3 of the foetal parameters. Some authors did a correlation study between PT, BPD and AC. In this study, we did a multiple correlation analysis between GA (USG), BPD, FL, AC, HC, FW and PT by using the Fishers' Z - transformation with a 5% confidence interval in the matrix form. Probably this could be the first study which did such a multiple correlation analysis. From [Table/Fig-4], it can be inferred that the correlation between the gestational age and the placental thickness was r= 0.968, which was significant at a 5% confidence interval. This shows a very high positive correlation between the GA and the placental thickness. From [Table/Fig-5], it can be inferred that 'all the product moment correlations' between any two variables are statistically significant (one tailed t test- All the P values were less than 0.001, thereby suggesting highly positive correlations).

Since there was a high positive correlation between the above said variables, we derived a regression equation for predicting the GA from the other foetal parameters, with minimal error.

Regression equation:

(x-22.92)=(0.3604) (w-27.86446)+ (1.0256)(y-1, 1678)+(0.0015) (z-216.2841)+(0.1047)(t-43.1555)(0.027)(u-192.7900)+(0.0042) (v=60.3725).

DISCUSSION

The placenta is a materno-foetal organ which forms a little later than the foetus; it nourishes and protects the foetus and it dies out after the delivery of the baby. Since it is closely related to the foetus and the mother, it acts like a mirror, reflecting the statuses of both the mother and the foetus. Kulman and Warsoff stated that a PT of < 25 mm at term, was associated with Intra Uterine Growth Retardation (IUGR) [5]. A placental thickness of > 40mm at term is associated with gestational diabetes, intra uterine infections and hydrops foetalis [6]. La Torre opined that at no stage of the pregnancy placental thickness exceeded 40 mm indirectly, thus indicating the cut off value for the upper limit [7]. Among the pregnant women with CMV infections, the placental thickness was increased in about 93.3% of the subjects [8]. Tsonge et al., in their study, found that the mean placental thickness between 18-21 weeks in normal pregnant women and in pregnancies with Hbbarts disease were 24.6 + 5.2mm and 34.5 + 6.7mm respectively. In this study which was done on normal singleton pregnancies, the mean placental thickness of the corresponding gestational weeks was 23.23mm [9]. The incidence of the perinatal mortality and the foetal anomalies were greater in the subjects with thick placentas [10]. Habib et al., in their study, said that the PT was 22mm at 36 weeks in the foetuses which weighed <2500gm and that the PT was 34.8mm at 36 weeks in the foetuses which weighed > 2500gm. They concluded that PT was a predictor of LBW infants [11]. In our study, the mean placental thickness at 36 weeks was 37.6mm. The placental thickness was increased in the subjects with α- thalassemia type 1 than in their normal counterparts [12]. From the above discussion, it is evident that a decreased PT is associated with IUGR. So, a subnormal PT may be an earliest indicator of IUGR ,which can be treated if it is diagnosed at the earliest. An enlarged placenta (placentomegaly) is suspected if the PT is > 40 mm at term and if it is associated with gestational Diabetes mellitus, intra uterine infections, hydrops foetalis, anaemia and α- thalassaemia type [1]. So, an increased PT for that GA should raise a suspicion about the possible disease conditions. PT is a GA dependent variable. In this study, from [Table/Fig-1& 2], it is evident that PT is in a linear relationship with GA. This study was in accordance with several other studies in this regards [12-15]. So, the substitution of any abnormal foetal parameters like BPD in hydrocephalus with PT in USG, in the GA estimation, can be ventured into. Since the above said studies were all cross sectional studies, it is unwise to declare that PT can be used as a reliable predictor of the gestational age. But there is a scope to venture into this segment and to come out with a refinement after taking up multicentre longitudinal studies with several large samples.

LIMITATIONS

This was a cross sectional study and we measured the placental thickness only once in each subject during the study. The sample size was small and there was only a single observer. Since a USG

measurement was done, there was a chance for an observer bias (intra observer variability), an instrumental bias, etc.

CONCLUSIONS

From our study, it can be concluded that PT can be used as a predictor of the GA, in the women in whom the LMP is unreliable or is not known. The substitution of any abnormal foetal parameters like BPD in hydrocephalus with PT in USG in the GA estimation can be ventured into. In abnormal PT for the corresponding GA, the disease conditions which cause an increased or decreased PT should be addressed. The regression equation can be used to calculate the GA from the other foetal parameters, with minimal error.

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AUTHOR(S):

1. Dr. T Karthikeyan
2. Dr. Ramesh Kumar Subramaniam
3. Dr. WMS Johnson
4. Dr. Prabhu K

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anatomy, Sree Balaji Medical College, Bharath University, Chennai,Tamilnadu, India.
2. Professor & HOD, Department of Anatomy, Sri Ramachandra University, Chennai, India.
3. Professor, Department of Anatomy, Sree Balaji Medical College, Bharath University, Chennai, Tamilnadu, India.
4. Associate Professor, Department of Anatomy, Sree Balaji Medical College, Bharath University, Chennai,Tamilnadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. T Karthikeyan,
Assistant Professor, Department of Anatomy,
5A, VV colony, 2nd street, Brindhavannagar,
Adambakkam,Chennai-600088,
Tamilnadu, India.
Phone: 9003450848
E-mail: tkarthiphoenix@gmail.com

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