Original Article

Development of a Nomogram to Evaluate the Usefulness of Sonographic Measurement of Placental Thickness for the Estimation of Fetal Gestational Age

Sandesh Ganjoo, Anita Sharma[1], Varun Kaul[2], Ghanshyam Dev[3], Sunil Kumar Raina[4], Diptiman Koul[5]

Department of Obstetrics and Gynecology, Dr. RPGMC, Tanda, [1]Government Medical College, Jammu, [2]Department of Paediatrics, [5]Department of Medicine, Government Medical College, Jammu, [3]Department of Radiodiagnosis and Imaging, Government Medical College, Jammu, Srinagar, [4]Department of Community Medicine, Dr. RPGMC, Tanda, Kangra, Himachal Pradesh, India

ABSTRACT

Background: An accurate assessment of gestational age (GA) and evaluation of fetal growth is fundamental to prenatal care. **Aim:** To evaluate placental thickness (PT) as an indicator of GA. **Subjects and Methods:** A prospective study was carried out on 300 antenatal patients with known last menstrual period (LMP), 100 each in first, second, and third trimester, respectively, with GA more than 10 weeks till term in a study period of one year. Patients with GA more than 20 weeks detected with pregnancy-induced hypertension (PIH) and/or diabetes mellitus (DM) and/or intrauterine growth retardation (IUGR) and/or hydrops fetalis and/or congenital malformation were excluded from the study. Twin pregnancy of any gestation was excluded from the study. The PT was measured at the level of insertion of the cord and the values thus measured in millimeters was correlated with GA as ascertained *vis a vis* the LMP. GA and PT were represented as mean and standard deviation. Correlation between them was evaluated using Pearson's product moment correlation coefficient. **Results:** The study showed a positive correlation between GA and PT. PT in millimeter accurately matched the GA in weeks from 14 to 21 weeks of gestation after which it was seen to be lesser than GA by 1-4 mm. **Conclusions:** PT promises to be an accurate parameter for estimating fetal GA in singleton pregnancies.

KEY WORDS: Fetal Gestational age, nomogram, placental thickness

INTRODUCTION

An accurate assessment of gestational age (GA) and evaluation of fetal growth is fundamental to prenatal care. Prediction of GA based on sonographic fetal parameters is perhaps the corner stone in modern obstetrics and continues to remain an important component in the management of pregnancies.

Several sonographic fetal parameters used to date pregnancy include fetal crown rump length (CRL), biparietal diameter (BPD), femur length (FL), head circumference (HC), and abdominal circumference (AC).[1]

BPD corresponds well with GA but since fetal head is quite malleable, therefore in breech presentations BPD is always lesser than normal fetuses. Also in brachycephaly, dolicocephaly, twins, and premature rupture of membranes, discrepancies with BPD measurement have been found.[2] There is a consistent sex-related difference in prenatal BPD, HC, and AC, which are established as early as 15 weeks of gestation.[3] BPD, HC, AC, and FL taken together have a better accuracy in predicting the GA rather than any of them independently.[4] Taking into consideration the shortcomings of various parameters estimating GA, a new parameter "placental thickness" (PT) to estimate the fetal GA is being evaluated. Added to this is the fact that the measurement of PT is relatively simple and clinically useful.[5]

The present study was undertaken to evaluate the accuracy of PT in the estimation of fetal GA and to apply the PT as an indicator of GA in patients with unknown last menstrual period (LMP).

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Address for correspondence
Dr. Sunil Kumar Raina,
Department of Community Medicine, Dr. RPGMC,
Tanda, Kangra, Himachal Pradesh, India.
E-mail: ojasrainasunil@yahoo.co.in

SUBJECTS AND METHODS

This study was conducted in the Department of Obstetrics and Gynecology, SMGS Hospital, Government Medical College, Jammu. Three hundred antenatal patients who attended the outpatient department and those who were admitted in the antenatal ward during the study period of one year (November 2008 to October 2009) with known LMP, 100 each in first, second, and third trimester, respectively, with GA more than 10 weeks till term, were included in the study group. Admitted patients included patients at term otherwise admitted for safe confinement and rest were seen on out-patient department (OPD) basis.

Patients with GA more than 20 weeks detected with pregnancy-induced hypertension (PIH) and/or diabetes mellitus and/or intr auterine growth retardation and/or hydrops fetalis and/or congenital malformation were excluded from the study. Twin pregnancy of any gestation was excluded from the study. Cases with PROM, chorioamniotis, history of premature labor or death, cases with uterine fibroids were excluded from the study.

A detailed history was enquired in each case and a thorough general physical, systemic, and obstetric examination was performed. All routine antenatal blood and urine investigations were done on the patients of the study group. After explaining the method and purpose of the procedure, an informed consent was obtained. Ultrasound examination was performed using a 2D real time mode by means of a transabdominal 3.5 MHz transducer of WIPRO GE make. GA was determined by measuring the CRL up to 11 weeks. After 11 weeks GA was determined by BPD and FL. The PT was measured at the level of umbilical cord insertion in the longitudinal direction and was correlated to the LMP and GA.

The study was approved by the institution ethics committee.

Statistical evaluation

All the data obtained was put in a tabulated form. GA and PT were represented as mean and standard deviation. Correlation between them was evaluated using Pearson's product moment correlation coefficient. Multiple linear regressions were applied to determine GA from PT. A *P* value less than 0.05 was considered as statistically significant unless specified otherwise. SPSS Statistical version 16.0 was used for analysis and interpretation of data.

RESULTS

The demographic parameters of the study population are described in Table 1. The present study used regression analysis to construct a nomogram for PT and established normal values of PT throughout pregnancy from 10 to 40 weeks and suggested that PT could even be used to estimate fetal GA in patients with unknown LMP.

The study results showed that there was an increase in PT with GA as shown in Table 2. The maximum PT of 38.2 mm was recorded at 40 weeks of gestation.

Table 1: Demographic pattern of study population

Age in years	No. of cases	Percentage
Age		
18-22	89	29.67
23-27	173	57.66
28.32	38	12.67
Socio economic class (Kuppuswamy)	**No. of cases**	**Percentage**
Socioeconomic status		
I	27	9
II	42	14
III	105	35
IV	87	29
V	39	13
	Primigravida	**Multigravidae**
Parity	188	112
	Rural	**Urban**
Residence	144	156

PS: There was no smoker in the study population

Table 2: Placental Thickness distribution *vis a vis* GA from 1st to 3rd Trimester

Gestational age (in weeks)	No. of cases	Placental thickness mean (SD) (mm)	95% confidence level
First trimester			
10	16	11.12 (1.39)	10.48-11.76
11	33	11.86 (0.97)	11.53-12.19
12	47	14.10 (1.45)	13.69-14.51
13	4	15.22 (2.19)	13.15-17.31
Mean placental thickness=12.80±1.81			
Second trimester			
14	3	14.73 (1.01)	13.59-15.87
15	8	16.45 (1.80)	15.2-17.7
16	12	16.49 (2.04)	15.28-17.7
17	12	17.64 (2.30)	16.44-18.84
18	11	19.33 (1.78)	18.22-20.44
19	3	19.73 (0.12)	19.59-19.87
20	3	20 (2.82)	16.18-23.19
21	11	21.83 (0.58)	21.47-22.41
22	11	21.65 (2.07)	20.43-22.87
23	10	22.53 (0.84)	22.01-23.05
24	3	21.8 (1.05)	20.61-22.99
25	3	21.57 (0.35)	21.17-21.97
26	4	24.15 (2.70)	21.5-26.8
27	3	23.23 (1.15)	21.93-24.53
28	3	22.23 (1.40)	20.65-23.81
Mean placental thickness=19.69±3.14			
Third trimester			
29	8	28.74 (1.37)	28.15-29.69
30	8	29.91 (1.55)	28.84-30.98
31	10	32.11 (1.19)	31.37-32.85
32	14	32.96 (1.34)	32.26-33.66
33	15	32.91 (1.83)	31.98-33.84
34	11	33.53 (1.92)	32.4-34.66
35	7	35.66 (1.40)	34.63-36.69
36	8	35.11 (1.77)	33.88-36.34
37	3	37.9 (0.3)	37.56-38.24
38	5	37.02 (2.42)	34.6-39.14
39	6	34.72 (1.98)	33.14-36.7
40	5	37.14 (0.67)	36.55-37.73
Mean placental thickness=33.38±2.82			

SD – Standard deviation; GA – Gestational age

The mean value of PT with respective standard deviation and along with their 95% confidence interval was calculated for GA from 10 to 40 weeks. It was observed that the mean PT increased from 11.2 mm at 10 weeks to 37.14 mm at 40 weeks.

Interestingly, three patients at term were having a PT of 31.8, 32.8, and 33.8 mm, which was strikingly lesser than the other patients in the study cohort. When these patients were followed up in terms of their neonatal outcome it was observed that the babies delivered by them were low birth weight.

Pearson's correlation analysis revealed that there was a significant positive relationship between PT and GA in the three trimesters and the combined trimesters as shown in Table 3.

Regression analysis yielded the following linear equations of relationship between GA (y) in weeks and PT in millimeter.

In the 1st Trimester:

$y = 0.285\ (PT) + 7.64\ (r = 0.68)$

In the 2nd Trimester:

$y = 1.030\ (PT) - 0.573\ (r = 0.81)$

In the 3rd Trimester:

$y = 0.8416\ (PT) + 5.57\ (r = 0.77)$

In the combined Trimester:-

$y = 1.0579\ (PT) - 1.6533\ (r = 0.98)$

The best fit mathematical models for 1st, 2nd, 3rd and combined trimester are shown in Figures 1-4, which were derived by regression analysis. Pearson's correlation values between PT and GA are given in Table 3.

DISCUSSION

It was seen that in the present study PT measured at the level of umbilical cord insertion from 10 to 40 weeks of gestation, increased linearly with advancing GA. This was in accordance with the study carried out by Jain *et al.*, who reported a linear increase in the value of PT with advancing GA from 10 to 39 weeks of gestation.[6] Mittal *et al.* also reported a similar gradual increase in the PT from 11 to 39 weeks of gestation.[7] In the present study, the PT increased from 11.2 ± 1.39 mm at 10 weeks of gestation to 34.14 ± 0.67 mm at 40 weeks of gestation, while Mittal *et al.* in their study reported an increase in PT from 15.3 ± 0.47 mm at 11 weeks of gestation to 37.5 ± 4.5 mm at 39 weeks of gestation.[7] This was in accordance with the study conducted by Jain *et al.*, but again, slightly higher (2 - 4 mm) than the present study in the 1st half of pregnancy, that is, 10-20 weeks.[6] The slightly higher value of their measurements could be attributed to a greater number of subjects and a couple of high values, which could have elevated the mean, included in their study.

Tongsong and Boonyanurak in their study showed an increase in PT from 8.4 ± 2.5 mm at 8 weeks to 21.8 ± 3.3 mm at 20 weeks of gestation.[7] This difference could be attributed to the ethnic variation in the study populations in the two groups. Ohagwu *et al.*, showed an increase in PT from

Table 3: Pearson's correlation values between PT and GA

	Trimester			
	First	Second	Third	Combined
Pearson's correlation coefficient ('r')	r=0.68	r=0.81	r=0.77	r=0.98
P value	<0.01	<0.01	<0.01	<0.01
Number of measurement	n=100	n=100	n=100	n=300

GA – Gestational age; PT – Placental thickness

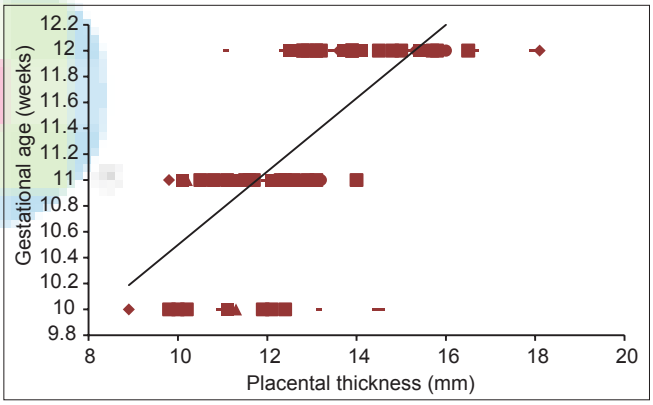

Figure 1: Graph of gestational age against placental thickness in the first trimester y = 0.285 (PT) + 7.64 R2 = 0.4628

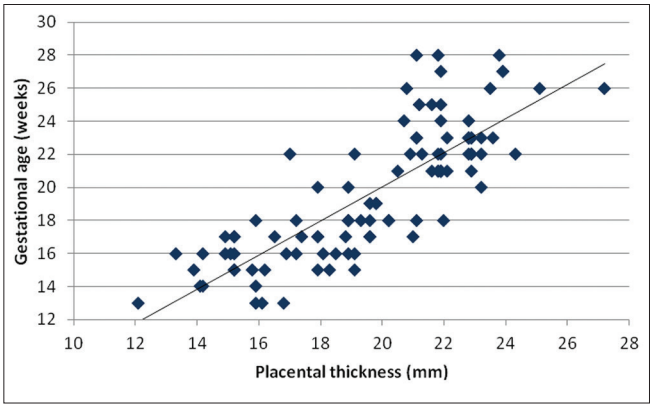

Figure 2: Graph of gestational age against placental thickness in the second trimester y = 1.030 (PT) – 0.573 R2 = 0.6621

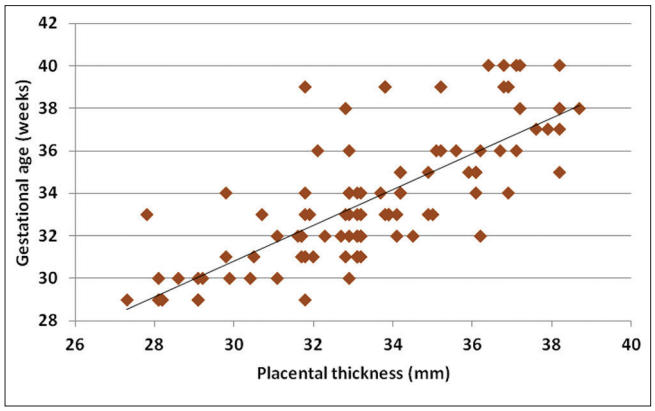

Figure 3: Graph of gestational age against placental thickness in the third trimester y = 1.0579 (PT) – 1.6533 R2 = 0.9554

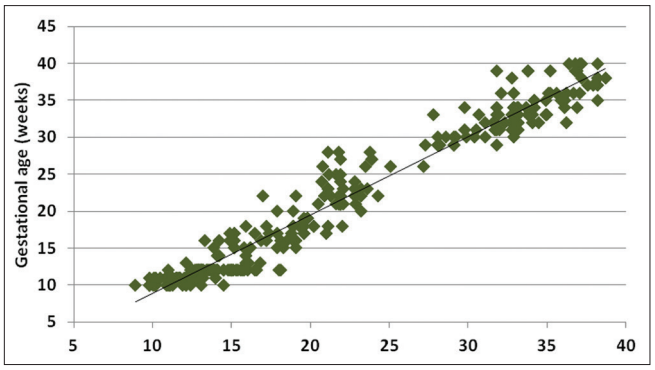

Figure 4: Graph of gestational age against placental thickness in the combined trimester y = 0.8416 (PT) + 5.57 R2 = 0.5852

10 ± 1.2 mm at 10 weeks to 43 ± 5.3 mm at 40 weeks of gestation.[8] The values of first trimester were comparable to the present study and were lesser by 2-4 mm from the results obtained by Jain *et al*. and Mittal *et al*. In the second and third trimester, the measurements obtained by Ohagwu *et al.* were about 5-7 mm higher as compared with all the studies. They could not exactly explain these higher measurement values, but attributed them to racial differences and presumed that the placenta might be normally thicker in the Negroes.[6-8]

In the present study, it was observed that during GA 10-13 weeks, PT was higher than GA by 1-2 mm. It matched GA almost equally between GA 14-21 weeks, after which it was slightly lower than GA by 1-3 mm till term. Jain *et al.* observed that from 10 to 25 weeks, the PT was higher than GA by 1-5 mm, they matched almost equally between GA of 27 and 33 weeks, after which they were slightly lower than GA by 1-3 mm up to term.[6] Mittal *et al.* reported similar observation that from 10 to 21 weeks of gestation, PT was slightly higher than GA by 1-4 mm, from 22 to 35 weeks almost matched GA in weeks, thereafter up to term PT was lower than GA by 1-2 mm.[7] Ohagwu *et al.,* in their study, observed that PT in millimeters equaled GA only at 10 and 11 weeks of gestation and observed no trend thereafter.[8]

The present study suggested that the measurement of PT could be used to sonographically estimate the GA of a fetus in women with unknown duration of pregnancy. Similar observations were suggested by various studies done by different authors in different areas.[6-9]

LIMITATIONS

Despite the effort to be methodologically correct, the study does have some limitations. Many weeks have only 3-4 subjects each only, which does not provide accurate data for interpretation. Therefore the interpretation for estimation of fetal GA using PT as a measure may not be conclusive.

Further given the variability in PT and potential effects of the contour of the uterine wall, the interpretation may not be accurate. However, the data does provide some insight into the fact that PT appears to increase with advancing GA. Future research in this area may provide more conclusive evidence in interpreting GA using PT as a marker.

REFERENCES

1. Schwarzler P, Bland JM, Holden D, Campbell S, Ville Y. Sex specific antenatal reference growth charts for uncomplicated singleton pregnancies at 15-40 weeks of gestation. Ultrasound Obstet Gynecol 2004;23:23-9.
2. Habaerkein CN, Smith DW, Jones KL. The “breech head” and its relevance. Am J Dis Child 1979;133:154-6.
3. Wolfson RN, Peisner DB, Chik LL, Sokol RJ. Comparison of BPD and FL in third trimester: Effects of gestational age and variation in fetal growth. J Ultrasound Med 1986;3:145-9.
4. Hanif M, Ghaffar A, Mahmood R. Estimating Gestational age of fetus by measuring placental thickness. J Surg Pak 2005;10:5-7.
5. Tongsong T, Boonyanurak P. Placental thickness in the first half of pregnancy. J Clin Ultrasound 2004;32:231-4.
6. Jain A, Kumar G, Aggarwal U, Kharakwal S. Placental thickness – a sonographic indicator of gestational age. J Obstet Gynae India 2001;51:48-9.
7. Mittal P, Hooja N, Mehndiratta K. Placental thickness: A sonographic parameter for estimation of gestational age of fetus. Indian J Radiol Imaging 2002;12:553-4.
8. Ohagwu CC, Abu PO, Udoh BE. Placental thickness: A sonographic indicator of gestational age in normal singleton pregnancies in Nigerian women. Internet J Med Update 2009;4:9-14.
9. Gilani S, Fazal N, Ahmad I. Estimation of placental thickness in 2nd and 3rd trimester and its correlation to gestational age in Pakistani population. Ultraschall in Med 2008;29-S4_OP4.

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