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Placental Thickness- A Sonographic Evaluation of Gestational Age

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ABSTRACT

Background: Ultrasound is being used in obstetrics for assessment of fetal well-being and for accurate assessment of gestational age. The various parameters used in ultrasonography are biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), crown-rump length (CRL) etc. The present study is conducted to assess the relationship of placental thickness with gestational age. **Methods:** A total of 100 normal pregnant cases were subjected to ultrasonographic examination and gestational age was calculated by measuring biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) by ultrasonography. Placental thickness was measured at the level of cord insertion with 3 Mhz sector probe. Symphysio-fundal height was also measured and gestational age was calculated by comparing with the standard chart. **Results:** A high degree of correlation is found between the gestational age and the fundal height ($r=0.991$, $p< 0.001$), bi-parietal diameter($r=0.964$, $p< 0.001$), head circumference ($r=0.979$, $p<0.001$), femur length ($r=0.99$, $p< 0.001$), abdominal circumference ($r=0.975$, $p<0.001$). **Conclusion:** In this work placental thickness was taken as a new parameter for predicting gestational age and a good correlation between them was marked ($r=0.993$, $p<0.001$).

Keywords: Gestational age, Obstetrics, Ultrasound.

INTRODUCTION

Accurate assessment of gestational age is an important part of any obstetrical examination. Clinical assessment of gestational age from first day of last menstrual period (LMP) is fraught with errors. Beazley and Underhill (1971) and Campbell (1974) reported that first day of last menstrual period was an unreliable indicator of actual gestational age. According to Sabbagha (1978), Hohler (1984), bi-parietal diameter (BPD) measurement by ultrasonography from 12 to 24 weeks of gestation gives accurate estimation of fetal age upto 95%. Ian Donald working in Great Britain introduced ultrasonography in obstetric and gynecology. Before seven weeks, biological variants such as gestational sac, yolk sac, fetal pole, cardiac blink could be considered for determination of gestational age. With improved resolution of diagnostic ultrasound equipments in the past decade, numerous structures have been shown to be highly correlated with gestational age like placental thickness, foot length, hand length, scapular length, kidney length, transcerebellar diameter, rib length etc. The placenta is a materno-fetal organ which begins developing at the implantation of the blastocyst and delivered with the fetus at birth. It has an important role in metabolic, endocrine and immunological function, besides being responsible for nutrition, respiration and excretion of the fetus. Lastly it acts as a barrier for protecting the fetus from noxious agents and some harmful drugs. Proper uteroplacental blood flow is necessary for fetal growth. Any impairment in the uterine blood flow hampers the growth of the placenta which inturn affects the growth of fetus. The present study is conducted to assess the relationship of placental thickness with gestational age.

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MATERIALS AND METHODS

A sum total of 100 normal pregnant cases attending antenatal clinic and admitted to indoor ward of

Obstetric unit of the Hi-Tech medical college were subjected to ultrasonographic examination on the basis of following criteria.

- Singleton pregnancy between 12 to 40 weeks of gestation
- All were very sure of their last menstrual period and had regular menstrual cycle prior to conception

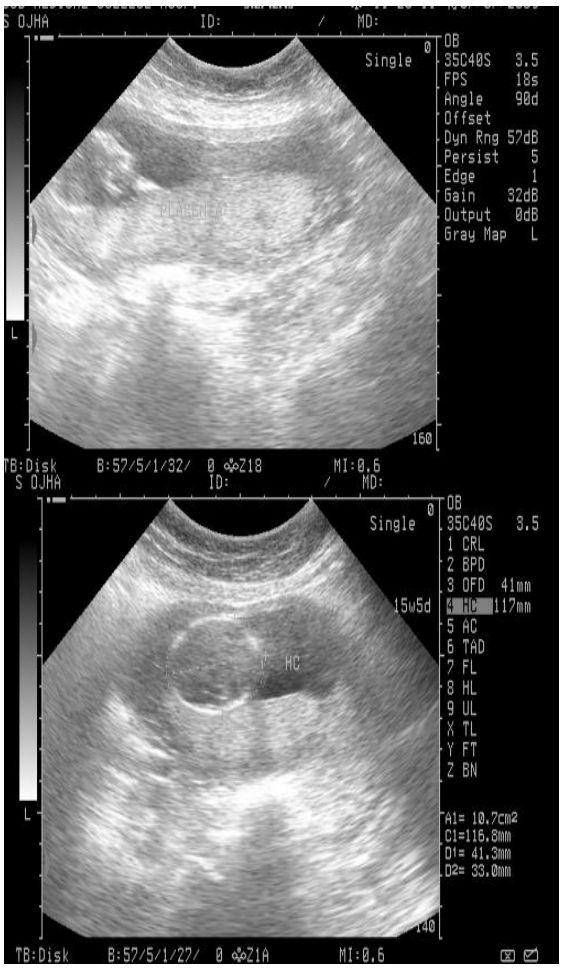
Exclusion criteria

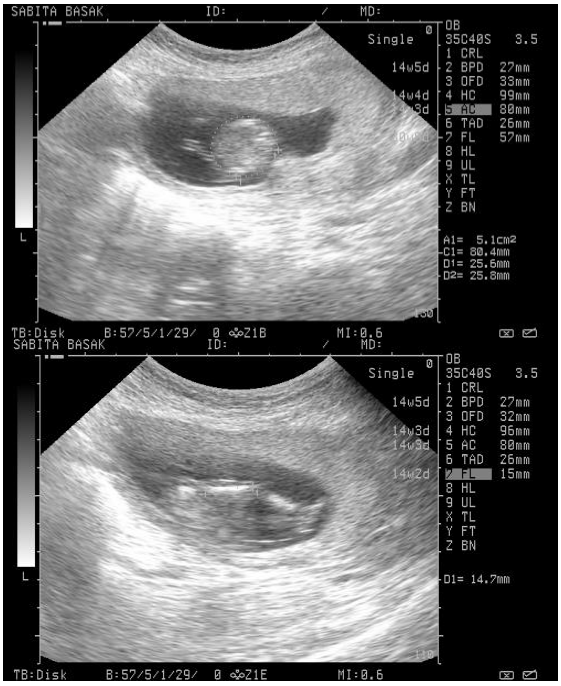
Pregnant women with the following criteria were excluded from the study

- Women suffering from diabetes mellitus
- Suspected fetal anomaly
- Infection (Cytomegalo virus, Syphilis, Toxoplasmosis)
- Non-immune hydrops fetalis
- Pregnancy induced hypertention
- Heart disease
- Chronic renal disease

All the study groups were having fundal height corresponding to the gestational age.

Gestational age was calculated by measuring biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) by ultrasonography. Placental thickness was measured at the level of cord insertion with 3 Mhz sector probe.





Placental thickness (Left upper), Head circumference (Right upper), Head circumference (Left lower), Femur length (Right lower) by USG

Clinical estimation of symphysio-fundal height- Patient was asked to lie supine with bladder empty. Fundus was defined by gentle pressure exerted at right angle to the abdominal wall using the cubital edge of the hand. A metric tape made of non elastic material was used. The distance between upper boarder of symphisis pubis to the upper boarder of uterine fundus was measured with tape lying in contact with the skin of the abdominal wall and was recorded. The measurements were compared with the standard chart of symphysio-fundal height plotted by Mathai et al (1987). The observations are tabulated and statistically analyzed by using SPSS software and by Anova method and coefficient test.

RESULTS

This study was undertaken on 100 normal pregnant women and the followings were obtained.

Table 1: Relation of Placental Thickness (mm) with Amniotic Fluid Index (AFI)

Sl. No	Placental Thickness	AFI(CM)
1	16-20	9-12
2	20-24	10-15
3	24-28	10-15
4	28-32	10-15
5	32-36	9-15

This table shows that placental thickness (mm) do not vary in relation to amniotic fluid index (AFI).

Table 2: Distribution of Height of Fundus in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl. No	Number of cases	Gestational Age(Wks)	Height of Fundus (Wks), Mean±2SD
1	8	12-16	14.25±1.67
2	13	16-20	18.92±1.27
3	13	20-24	21.69±1.97
4	14	24-28	26.13±1.6
5	15	28-32	30.71±1.68
6	19	32-36	34.21±1.31
7	18	36-40	37.78±0.65

From the above data it can be concluded that the height of fundus increases in linear fashion with the increase in gestational age.

Table 3: Distribution of Symphysio-fundal Height in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl. no.	No. of cases	Gestational age (weeks)	SFH (cm), Mean±2SD
1	8	12-16	7.6±0.29
2	13	16-20	11.68±1.75
3	13	20-24	14.88±2.16
4	14	24-28	23.14±1.60
5	15	28-32	29.53±1.84
6	19	32-36	33.46±1.61
7	18	36-40	34.89±0.62

The above table shows the distribution of symphysio fundal height in 2nd and 3rd trimester and that as the gestational age advances the height of the uterus from the symphysis pubis increases.

Table 4: Distribution of Fetal Biparietal Diameter in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl no.	No of cases	Gestational age(Wks)	BPD (cm), Mean±2SD
1	8	12-16	2.57±0.71
2	13	16-20	4.24±0.42
3	13	20-24	5.37±0.50
4	14	24-28	6.6±0.6
5	15	28-32	7.6±0.26
6	19	32-36	8.62±0.27
7	18	36-40	8.81±0.86

The table shows the distribution of fetal biparietal diameter in 2nd and 3rd trimester of pregnancy. The fetal BPD increases with the increase in gestational age.

Table 5: Distribution of Fetal Head Circumference in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl No.	No of Cases	Gestationalage(Wks)	HC (cm), Mean±2SD
1	8	12-16	9.75±1.87
2	13	16-20	15.67±1.53
3	13	20-24	19.71±1.86
4	14	24-28	24.17±2.21
5	15	28-32	28.0±0.83
6	19	32-36	30.99±1.15
7	18	36-40	32.29±0.87

The table shows the distribution of fetal head circumference in 2nd and 3rd trimester of pregnancy. From the above table it can be concluded that the fetal head circumference increases with the increase in gestational age.

Table 6: Distribution of Fetal Femur Length in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl No	No. of cases	Gestational age(Wks)	FL (cm), Mean±2SD
1	8	12-16	1.56±0.37
2	13	16-20	2.89±0.38
3	13	20-24	3.82±0.38
4	14	24-28	4.88±0.42
5	1	28-32	5.7±0.28
6	19	32-36	6.68±0.27
7	18	36-40	7.18±0.22

From the above table it can be concluded that the fetal femur length increases with the increase in gestational age.

Table 7: Distribution of Fetal Abdominal Circumference in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl No	No. of Cases	Gestational age(Wks)	AC (cm), Mean±2SD
1	8	12-16	8.17±1.47
2	13	16-20	14.47±3.50
3	13	20-24	17.5±1.5
4	14	24-28	21.64±2.1
5	15	28-32	26.1±1.12
6	19	32-36	30.76±1.6
7	18	36-40	32.48±1.32

From the above table it can be concluded that the fetal abdominal circumference increases with the increase in gestational age.

Table 8: Distribution of Placental Thickness in 2nd and 3rd Trimester at increasing interval of 4 Weeks

Sl. No	No. of Cases	Gestational age (Weeks)	PT (mm), Mean±2SD
1	8	12-16	17.75±1.42
2	13	16-20	22.08±0.16
3	13	20-24	24.17±0.59
4	14	24-28	27.74±0.31
5	15	28-32	31.12±0.5
6	19	32-36	33.02±0.1
7	18	36-40	35.92±0.2

It can be concluded from the above table that the placental thickness increases with the increase in gestational age.

Table 9: Correlation Matrix of Gestational Age with Fetal Ultrasonographic Parameters (n=100)

Sl. No.	Parameter	Correlation coeff. (r)	p-value
1	Ht of Fundus	0.991	<0.001
2	Symphysio-fundalheight	0.978	<0.001
3	Biparietal Diameter	0.964	<0.001
4	Head Cicumference	0.979	<0.001
5	Femur Length	0.99	<0.001
6	Abdominal Circumference	0.975	<0.001
7	Placental Thickness	0.993	<0.001

The above table shows that all the ultrasonographic parameters have correlation coefficient (r>0.9) i.e. all the parameters have high degree of correlation with the gestational age. All the above parameters are also highly significant, (p< 0.001).

Table 10: Correlation Matrix of Gestational Age Parameters (Sub-Group Analysis in 2nd Trimester, n=49) with Fetal Ultrasonographic

Sl. No.	Parameter	Correlation coeff. (r)	p-value
1	Ht of Fundus	0.975	<0.001
2	Symphysio-fundal height	0.944	<0.001
3	Biparietal Diameter	0.979	<0.001
4	Head Cicumference	0.981	<0.001
5	Femur Length	0.989	<0.001
6	Abdominal Circumference	0.911	<0.001
7	Placental Thickness	0.987	<0.001

The correlation matrix shows that in 2nd trimester sub-group the ultrasonographic parameters have high degree of correlation (r>0.9) and are highly significant (p<0.001).

Table 11: Correlation Matrix of Gestational Age with Fetal Ultrasonographic Parameters (Sub-Group Analysis in 3rd Trimester, n=51)

Sl. No.	Parameter	Correlation coeff. (r)	p-value
1	Ht of Fundus	0.977	<0.001
2	Symphysio-fundal height	0.949	<0.001
3	Biparietal Diameter	0.981	<0.001
4	Head Cicumference	0.983	<0.001
5	Femur Length	0.99	<0.001
6	Abdominal Circumference	0.919	<0.001
7	Placental Thickness	0.988	<0.001

The correlation matrix in third trimester shows that the ultrasonographic parameters have high degree of correlation (r>0.9) and are highly significant (p<0.001).

DISCUSSION

Estimation of gestational age and thereby forecasting the expected date of delivery (EDD) is not only the concern of the individual but it is invaluable in the diagnosis of intrauterine growth retardation of the fetus or management of high risk pregnancy. In 20%-30% cases the pregnant women either fail to remember the LMP or report inaccurately. It becomes a concern when the conception occurs during lactational amenorrhea or soon following withdrawal of contraceptive pills or in cases with bleeding in early part of pregnancy.

A high degree of correlation is found between the gestational age and the fundal height (r=0.991, p< 0.001). Here the fundal height is compared with the anatomical landmarks on the abdomen and the gestational age. The symphysio-fundal height (SFH) is measured by a tape from the upper boarder of the symphysis pubis up to the upper boarder of the fundus. A variation of ±2 cm is accepted as normal. In the present study from 12-20 wks and after 24 wks the variation is less than ±2 cm. Jiminez JM et.al. (1983) found that the fundal height reached umbilicus between 15-19 weeks and SFH as a better predictor of gestational age after 24 weeks. Geirsson RT et.al. (1987) found that advancing gestation increases the correlation between the fundal height and gestational age. Engstrom JL (1987) found that several factors can alter the accuracy of fundal height measurement like variability in the anatomical abdominal landmarks, finger breadth, transverse lie of the fetus, fullness of the bladder and maternal position. They found SFH to be a better parameter than the fundal height. Mathews Mathai et.al. (1987) observed that the measurement of the fundal height has high sensitivity (84%) and specificity (88%) for predicting gestational age. Traisathit P et.al. (2006) found that the fundal height measurement after 24 wks is an efficient estimate of gestational age.

A strong correlation is found between the biparietal diameter and the gestational age with a correlation coefficient (r=0.964, p< 0.001) which shows that BPD is one of the important sonographic parameters for determining gestational age. Warsof et.al. (1986) observed that BPD is highly specific but its sensitivity is only 52%. N J Secher et.al. (1987) studied 2771 pregnant women and concluded, BPD as a useful measure for determining gestational age before 22 weeks. Dilmen G et.al. (1995) showed a high degree of correlation between BPD and gestational age (r=0.948, p<0.001).

A high degree of correlation is found between the head circumference and gestational age (r=0.979, p<0.001). In conditions like altered shape of the head, the head circumference acts as a better parameter than the BPD for predicting gestational age. CB Benson et.al. (1991) studied 460 fetal sonograms obtained at 14-42 weeks of gestation and found that the accuracy of all predictors worsened progressively as pregnancy proceeded. In the 2nd trimester corrected BPD and HC were more accurate predictors of gestational age than were BPD, FL and AC (p< 0.05, F test).In the third trimester the corrected BPD, HC and FL were the best predictors (p<0.05, F test). Chervenak (1998) assessed the accuracy of fetal biometry in the midtrimester for the assessment of fetal age and concluded that addition of abdominal circumference and femur length to the HC improves the accuracy of the dating equation. Daniel Salpou et.al. (2008) studied 200 healthy pregnant women having regular menstrual cycle and singleton uncomplicated pregnancy. They concluded BPD, HC and FL as the most commonly

used parameters for the assessment of gestational age. According to them these parameters are less influenced by parity, age and fetal gender.

A high degree of correlation is found between femur length and gestational age (r=0.99, p< 0.001). The mean femur length increases with the increase in gestational age. These findings corroborate with the datas present in ultrasonographic fetal growth chart. Peter et.al. (1985) reported femur length as a valuable tool for predicting gestational age when the findings from other methods are unreliable. Jeanty et. al. (1985) observed a high degree of correlation between femur length and gestational age (r=0.96, p<0.001). Murao F et.al. (1989) studied 76 fetuses from 14-40 wks of gestation and observed a high degree of correlation between femur length and gestational age (r=0.95). Dilmen G et.al. (1995) observed a high degree of correlation between femur length and gestational age (r=0.94, p< 0.001).

Abdominal circumference is highly correlated with the gestational age in this study (r=0.975, p<0.001). Murao F et. al. (1989) found a good correlation between abdominal circumference and gestational age (r=0.91). Dilmen G et. al. (1995) found a good correlation between AC and gestational age (r=0.95, p<0.001).

In this work placental thickness was taken as a new parameter for predicting gestational age and a good correlation between them was marked (r=0.993, p<0.001). In between 12-16 weeks of gestational age the mean placental thickness is 17.75±1.42 mm (2SD), 16-20 wks it is 22.08±0.16 mm (2SD), 20-24 wks it is 24.17±0.59 mm (2SD), 24-28 wks it is 27.74±0.31 mm (2SD), 28-32 wks it is 31.12±0.5 mm (2SD), 32-36 wks it is 33.02±0.2 mm (2SD), 36-40 wks it is 35.92±0.1 mm (2SD). Before 24 weeks the placental thickness is slightly higher than the corresponding gestational age. From 24-36 week the mean placental thickness in mm match the gestational age in weeks. There after the mean placental thickness is less than the gestational age. These findings are consistent with the observation made by Mital P et. al. (2002) who found that the value of mean placental thickness increases with advancing gestational age almost match from 22-35 week. They concluded that the measurement of placental thickness is an important parameter for estimation of fetal age. Anupam Jain et. al. (2001) reported that the value of mean placental thickness increases with advancing gestational age and almost match from 27-33 weeks. Kobayashi (1970) and Gottesfield (1966), Nyberg and Finberg (1990) also reported that the mean placental thickness increases in parallel with the gestational age. Fawzia A Habib (2002) studied 70 pregnancies and reported that a warning limit of placental diameter of 18 cm and placental thickness of 2 cm at 36 week were calculated to predict low birth weight infants. They also reported that maternal variables such as age, parity, body mass index do not associate significantly with low birth weight infants. According to them ultrasonographic placental diameter and thickness measurements appears to be of prognostic value in identifying the subsequent occurrence of fetal growth retardation. U. Elchalal et.al. (2000) studied in 561 normal pregnancies and reported that no correlation was found between the placental thickness and maternal age or parity. They also stated that placental thickness increases linearly from 16 weeks onwards throughout pregnancy and sonographically thick placenta is associated with increased perinatal mortality and morbidity. Jauniaux (1994) reported that from 16-20 weeks of gestational age the placental thickness increases in a linear fashion with the gestational age. F. Doize (1995) in study on sheep and goat, found a strong correlation between placental thickness and gestational age in goat, but not in sheep. Gilani SA et. al. studied 1000 cases and reported that in 90% of cases placental thickness of ±5mm (1SD) correspond with the gestational age and in all the cases mean placental thickness of ±10mm (2SD) correspond with the gestational age. According to them from 21-35 week the placental thickness almost matches with the gestational age in weeks, thereafter it lowers by 1-2 mm.

CONCLUSION

It is concluded from the present study that ultrasonographic measurement of placental thickness is correlated well with the gestational age which can be used as a reliable indicator for estimation of gestational age and IUGR. Measurement of placental thickness is of paramount importance when other parameters do not accurately predict gestational age in certain conditions like anencephaly, hydrocephaly, short limb dysplasia etc.

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