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RESEARCH ARTICLE

ULTRASONOGRAPHIC MEASUREMENT OF PLACENTAL THICKNESS AND ITS CORRELATION WITH GESTATIONAL AGE – A CROSS-SECTIONAL ULTRASONOGRAPHIC STUDY.

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Abstract

Introduction:- Study of placental morphology is a part of the overall assessment of intrauterine environment. Placental growth can be estimated by either measuring the thickness or estimating its volume. Placental thickness is directly related to the gestational age of the foetus during certain period of pregnancy. Thus placental thickness can be used to determine the gestational age.

Objectives:- The purpose of the present study was to determine the normal range of placental thickness in study population in first and second trimesters of pregnancy and its correlation with gestational age of the foetus.

Methods:- 153 cases were recruited for the study who came for routine antenatal check-up to Department of Radiology in collaboration with Department of Obstetrics and Gynaecology, tertiary care service hospital. Subjects who had any obstetrical, gynaecological, medical and surgical illnesses were excluded. Placental thickness was measured at the level of umbilical cord insertion.

Result:- placental thickness ranged from 11.4 mm to 28.2 mm with majority having placental thickness in the range 16 to 28 mm. Astrong correlation between gestational age and placental thickness was observed (r=0.9994 for biometric GA and r=0.9673 for LMP based GA).

Discussion:- PT has a linear relationship with GA. It can be therefore concluded that PT can be used as a predictor of the GA in women with unreliable or unknown LMP. The substitution of any abnormal parameter like BPD in hydrocephalus with PT in sonography for GA estimation is also suggested.

Introduction:-

Monitoring fetal growth and assessing its parameters have important place in antenatal care management. Accurate prediction of gestational age (GA) and birth weight (BW) is clinically important. With the advent of imaging devices that can be used during pregnancy without side effect, attempts have been made to evaluate various maternal and fetal morphological changes during pregnancy as the basis for assessment of gestational age and fetal growth.

Placental Morphology:-

Grannum et al. (1979)[1] devised systemic classification of ultrasonographic morphology of placenta, based on the changes occurring in the chorionic plate, placental substance and the basal layer, the three separate zones of placenta. The placenta was grouped into four grades from zero to three.

According to Petrucha and Piatt (1982)[2] all placenta start as grade zero. The mean gestational age at which the placenta matures to a Grade I is 31.11 weeks, Grade II, 36.36weeks and Grade III, 38.04 weeks.

Placental Thickness:-

Jain et al. (2001) reported that the value of mean placental thickness increases with advancing gestational age and almost matched the gestational age from 27 to 33 weeks.[3] Mital et al. (2002) conducted a study the aim of evaluating placental thickness, measured at the insertion of the umbilical cord, as a parameter for estimating gestational age of the fetus3. They observed that placental thickness gradually increased from 15 mm at 11 weeks of gestation to 37.5 mm at 39 weeks. It was concluded that the measurement of the placental thickness is an important parameter for estimation of fetal age along with other parameters especially in the late mid trimester and early third trimester, where the exact duration of pregnancy is not known.[4]

Karthikeyan et al.(2012) estimated the (Placental Thickness) PT and at investigating the relationship between PT and the foetal growth parameters in normal singleton pregnancies[5]. 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, HC and FW also. They concluded 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.[5]

The present study was carried out with an aim to evaluate the efficacy of placental thickness as tool for gestational age estimation in normal singleton pregnancies by comparing it to sonographic gestational age using fetal biometry and correlating with the actual gestational age.

Material And Methods:-

Settings:- Department of Radiology in collaboration with Department of Obstetrics and Gynaecology, tertiary care service hospital.

Study type:- Cross-sectional

Study period :- May 2014 –June 2015.

Patient selection:- Pregnant women presenting after 10 weeks of pregnancy.

Sampling Frame:- The sampling frame was bound by the following inclusion and exclusion criteria

Inclusion Criteria:-

1. Women with Singleton pregnancies, 11-28 weeks.
2. Known last menstrual period.
3. Having a history of regular menstruation.

Exclusion criteria:- Cases with following conditions were excluded from the study:

1. Pregnant women having gestational diabetes, hypertension (systemic / Pregnancy induced) and/or anaemia.
2. Pregnancies diagnosed with foetal anomalies.
3. Multiple pregnancies.
4. Last menstrual period not known or irregular menstrual periods.
5. Women not willing to participate in the study.

After obtaining informed consent from the patients, demographic details, medical and obstetric history and details of current pregnancy were noted to rule out GDM, anemia and hypertension.

Procedure:-

Obstetrics USG was performed. The gestation age was determined by measuring the biparietal diameter, the abdominal circumference, the crown rump length, the head circumference and the femur length. Placental morphology was noted and graded as per the criteria of Grannum1. The placental thickness was measured at the level of the umbilical cord insertion/midpoint; the maximum thickness was noted in the cross section measured to a 1 mm precision, which was perpendicular to the uterine wall.

The calculated gestational age was correlated with the actual gestational age.

Results:-

The present study was carried out with an aim to evaluate efficacy of placental morphological and fetal biometric parameters during different stages of pregnancy and to assess the gestational age on the basis of these parameters. For this purpose, a total of 153 subjects falling in sampling frame were enrolled in the study and were subjected to USG evaluation.

Age of women ranged from 19 to 42 years. Maximum number of cases were aged 26-30 years (47.3%) followed by those aged 21-25 years (35.9%), 31-35 years (12.5%) and those aged <20 years (2.7%). There were only 4 (1.6%) cases aged >35 years. Mean age of cases was 26.75±3.61 years.

Table 1 shows distribution of cases according to gestational age at the time of enrolment.

Table 1: Distribution of women enrolled in the study according to gestational age at enrolment (according to LMP)

SN	Gestational Age (Weeks)	No. of cases	Percentage
1.	<12	4	2.6
2.	12-18	39	25.4
3.	19-24	89	58.1
4.	25-28	21	13.7

Gestational age of cases ranged from 11 weeks 1 day to 28 weeks3 days respectively. Maximum number of cases reported at a gestational age of 19-24 weeks (n=89; 58.1%). There were 39 (25.4%) who reported at a gestational age of 12-18 weeks, 21 (13.7%) reported at a gestational age of 25-28 weeks. There were only 4 (2.6%) women who reported at a gestational age of 10-12 weeks.

USG Evaluation Findings:-

a) Maternal Parameters (Placenta)

Placental position and Placental grading

Placenta was found to be positioned anteriorly in majority of cases (n=78; 50.1%) followed by those having posteriorly positioned placenta (n=61; 39.8%). There were 12 (7.8%) cases having fundo-posterior and 1 (0.6%) having fundoanterior placental. There was one (n=1; 0.6%) case with fundal placenta.

Majority had Grade I placenta (n=137; 89.5%) followed by those having Grade 0 placenta (n=16; 10.4%). A significant increase in gestational age was observed with increasing placental grade ($p<0.001$).

Correlation between Placental Thickness and Gestational Age (Weeks):-

Placental thickness was found to range from 11.4 mm to 28.2 mm. With increasing placental thickness, an increasing trend of gestational age was observed which was also significant statistically ($p<0.001$). The correlation between gestational age (biometric) and placental thickness was stronger ($r=0.9994$) than correlation between gestational age (LMP based) and placental thickness ($r=0.9673$).

Incremental increase in placental thickness was noted in the 1st trimester (10-12 weeks) and 2nd trimester (13-28 weeks). On comparing the relationship of GA and PT in each trimester based on data given in Table 7 and 9, Pearson's correlation analysis revealed that there was a significant positive relationship between placental thickness and gestation age in both trimesters and it was observed that the correlation was stronger with GA based on biometry in both trimesters as shown in table 2 and 3.

Table 2: Pearson correlation coefficient between PT and GA (biometric)

Trimester	Sample size	Mean PT	SD	Correlation coefficient (r)	P value
T1	6	11.95	0.45	0.859	0.028
T2	147	20.14	3.49	0.993	<0.001
		F=560.52; p<0.001			

Table 3: Pearson correlation coefficient between PT and GA (LMP based)

Trimester	Sample size	Mean PT	SD	Correlation coefficient (r)	P value
T1	7	12.01	0.44	0.741	0.057
T2	146	20.02	3.27	0.996	<0.001
	153	F=634.31; p<0.001			

With increasing calculated gestational age a significant increase in mean placental thickness was observed. The correlation between calculated gestational age and placental thickness was strong (r>0.85; p<0.05).

With increasing gestational age(based on LMP) a significant increase in mean placental thickness was observed as shown in table 4. The correlation between calculated gestational age and placental thickness was strong and significant statistically too for second and third trimesters (r>0.9; p<0.001). For first trimester, though the correlation was strong (r>0.7) yet it was not significant statistically.

Table 4: Association between placental thickness and calculated gestational age (based on Biometry)

CGA (Biometry)	No. of cases	Placental thickness		95% Confidence Intervals	
		Mean	SD	Lower	Upper
First trimester					
11	3	11.60	0.35	10.74	12.46
12	3	12.30	0.10	12.05	12.55
Second trimester					
13	4	12.48	0.10	12.32	12.63
14	4	14.00	0.41	13.35	14.65
15	2	14.40	0.00	14.40	14.40
16	2	15.45	0.07	14.81	16.09
17	6	17.25	0.18	17.07	17.43
18	25	18.16	0.37	18.01	18.31
19	41	19.17	0.50	19.01	19.33
20	25	19.99	0.37	19.84	20.14
21	8	21.00	0.48	20.60	21.40
22	5	22.28	0.22	22.01	22.55
23	3	23.27	0.21	22.75	23.78
24	1	24.00	.	.	.
25	8	25.16	0.16	25.03	25.30
26	4	26.28	0.22	25.92	26.63
27	5	26.98	0.18	26.76	27.20
28	7	28.20	0.28	27.94	28.46

For all the fetal parameters a strong correlation with placental thickness was observed. Placental thickness had strongest correlation with femur length as shown in table 5. For all the parameters, the correlation with placental thickness was significant statistically (p<0.001).

Table 5: Correlation between Placental Thickness and Different Fetal parameters studied.

SN	Parameter	No. of samples	"r"	"p"
1.	Biparietal diameter	139	0.996	<0.001
2.	Head circumference	139	0.956	<0.001
3.	Abdominal circumference	139	0.995	<0.001
4.	Femur length	139	0.997	<0.001

With increasing gestational age an increase in placental thickness was observed as shown in table 6.

Table 6: Association between placental thickness and gestational age (based on LMP).

GA (LMP)	No. of cases	Placental thickness		95% Confidence Intervals	
		Mean	SD	Lower	Upper
First trimester					
11	3.00	11.60	0.35	10.74	12.46
12	4.00	12.33	0.10	12.17	12.48
Second trimester					
13	3.00	12.50	0.10	12.25	12.75
14	5.00	14.08	0.40	13.59	14.57
15	1.00	14.40	.	.	.
16	2.00	15.45	0.07	14.81	16.09
17	5.00	17.22	0.18	17.00	17.44
18	20.00	18.03	0.39	17.85	18.21
19	39.00	19.01	0.47	18.86	19.17
20	30.00	19.81	0.52	19.61	20.00
21	10.00	20.69	0.41	20.40	20.98
22	3.00	22.07	0.21	21.55	22.58
23	6.00	22.82	0.53	22.26	23.37
24	1.00	24.00	.	.	.
25	8.00	25.16	0.16	25.03	25.30
26	3.00	26.17	0.06	26.02	26.31
27	5.00	26.86	0.19	26.62	27.10
28	5.00	27.90	0.44	27.36	28.44

Results of past studies on correlation of placental thickness and gestational age is compared with present study in Table 7.

Table7 : Correlation of placental thickness and gestational age.

SN	**STUDY BY**	**PUBLISHED IN**	**CORRELAION OF PT WITH GA(r value)**			**P value**
			1st TRI	**2nd TRI**	**3rd TRI**	
1	Karthikeyan et al	J Clin Diagn Res. 2012	0.609	0.812	0814	<0.01
2	Ahmed et al	J. App. Med. Sci., 2014; 2(1D)	Not studied	Not studied	0.85	<0.01
3	Preeti Baghel et al	IJMR/2014(13676-2057)	Not studied	0.668	0.735	<0.01
4	Present study		0.859	0.993	Not studied	<0.001

Discussion:-

In utero estimation of fetal age in consonance with gestational age is one of the methods that helps in estimation of any fetal growth restriction and fetal well being as well as for the purpose of management of a planned delivery. Imaging techniques provide a basis for visualizing the changing fetal and maternal biometrics that can be helpful in monitoring the progress of pregnancy as well as fetal development. Ultrasonographic assessment of pregnancy helps to monitor the progression of pregnancy and has widely been used for the purpose of assessment of maternal and fetal well-being as well as for determination of gestational age on the basis of fetal biometric and maternal parameters. Presently the most effective way to date pregnancy is by measurement of fetal parameters by sonography and these include CRL, BPD, HC, FL and AC. Sonographic measurements of placental thickness have been described in literature and it has been suggested that placental thickness measured at the level of umbilical cord insertion may be useful in assessment of gestational age. In present study, we made an attempt to focus on correlation of placental thickness with gestational age based on fetal biometry and LMP in different stages of pregnancy.

For this purpose a total of 153 pregnant women with singleton normal pregnancy at gestational age 11 weeks 1 day to 28 weeks 4 days were enrolled in the study. The age of pregnant women enrolled in the study ranged from 19 to

42 years. The maternal age thus showed a wide variability (23 years). Although advancing age is reported as a risk factor[i], however, in present study it was ascertained that the pregnancies are risk free.

In first part of study, an evaluation of placental morphology during different stages of pregnancy was made. Most of the pregnancies had anterior (n=78; 50.1%) or posterior (n=61; 39.8%) placenta and placental position did not show a significant association with gestational age.

In present study, majority of patients had placental grade I (n=137; 89.5%) followed by grade 0 (10.4%). A significant association between gestational age and grade of pregnancy was observed. It was observed that with increasing gestational age, an increment in placental grade took place ($p<0.001$). In present study mean gestational age of women with grade 0 and grade I was observed to be 13.0±1.3 and 20.8±3.3 weeks respectively. This finding is in consistency with the observations of Petrucha and Piatt (1982)[2] who showed that all placenta start as grade zero. In present study, as most of the cases were in second trimester of pregnancy, the prevalence of Grade I was higher**.**

In present study, placental thickness ranged from 11.4 mm to 28.2 mm with majority having placental thickness in the range 16 to 28 mm. With increasing age, mean gestational age was found to be increasing and a strong correlation between gestational age and placental thickness was also observed (r=0.9994 for biometric GA and r=0.9673 for LMP based GA). We observed that the placental thickness (in mm) almost matched the biometric gestational age (in weeks) in 29 (18%) cases. Using placental thickness, majority of cases (n=116; 76%) had predicted gestational age with a difference within ±3 days of gestational age (biometric). A total of 32 (21.5%) had a difference of 3-7 days from gestational age and 5 (3.2%) had a difference of >7 days. Mean gestational age for the range of placental thickness values coincided with the midpoint of that range thus endorsing the view of Jain et al. (2001) that the value of mean placental thickness increases with advancing gestational age and almost matched the gestational age from 27 to 33 weeks[4]. Similar to our study, a strong correlation (r>0.7) between placental thickness and gestational age was also observed by Karthikeyan et al. (2012)[5].

The findings of present study showed a strong correlation between placental thickness and fetal biometric parameters, thereby showing a significant association between placental and fetal growth trends. A similar association has also been reported in various studies in literature[ii]. In present study it was observed that correlation of placental thickness is stronger with biometric GA (r=0.9994) than correlation with LMP based GA (r=0.9673).

From above discussion, it is evident that PT has a linear relationship with GA. It can be therefore concluded that PT can be used as a predictor of the GA in women with unreliable or unknown LMP. The substitution of any abnormal parameter like BPD in hydrocephalus with PT in sonography for GA estimation is also suggested. We are of the opinion that placental thickness is an accurate parameter for estimating GA in singleton pregnancies. It is therefore suggested that measurement of placental thickness should be carried out routinely during obstetric ultrasound scans.

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