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Original Article

Obstetrics and Gynaecology Section

Correlation of Placental Thickness Estimated by – Ultrasonography with Gestational Age and Fetal Outcome

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ABSTRACT

Introduction: A normally functioning placenta is critical for normal fetal growth and development. The size of placenta increases during fetal growth to allow it to do its vital functions. If the fetal growth is compromised, it is due to the abnormal function of the placenta, it can be detected by the abnormal placental measurements. A "point of confinement" is that, the placental width of 18 cm placental thickness of 2 cm at 36 weeks predicts a low conception weight neonate.

Aim: To compare fetal gestational age estimated by placental thickness with other parameters of fetal growth as BPD, FL, AC and HC, and to evaluate the role of placental thickness estimation in predicting LBW & IUGR.

Materials and Methods: One Hundred pregnant patients, who were sure of dates and fulfilling inclusion and exclusion criteria were recruited from ANC clinic at 24 weeks and were followed at 32 weeks, 36 weeks. The gestational age was estimated by USG using various growth parameters: BPD, FL, AC and the placental thickness was measured in longitudinal direction at the level of insertion of umbilical cord. Mean and SD were used to summarize continuous maternal variables. Pearson's correlation analysis and p values were calculated by the 2-tailed significance.

Result: The Pearson's correlation coefficient(r) of placental thickness and composite gestational age being 0.629 (p= 0.000) at 24 weeks, r = 0.668 (p= 0.000) at 32 weeks and r= 0.735 (p= 0.000) at 36 weeks which is statistically significant. Placental thickness < 10^{th} percentile at-32 and 36 weeks could detect IUGR with a sensitivity of 53.5%, specificivity of 92 % and positive predictive value of 80%.

Conclusion: Placental thickness on USG seems to be a promising parameter for estimation of gestational age of the fetus and predicting fetal outcome as placental thickness in mm almost equals gestational age in weeks, placental thickness below 10^{th} percentile was found to be associated with low birth weight and IUGR.

Keywords: Fetal growth parameters, IUGR, LBW, Pregnant patients

INTRODUCTION

The placenta 'the sprightliness of fetus in utero' functions diversely to reinforce the maturation of the fetus and interacts with the two individuals- mother & developing fetus .The placenta, a highly vascular fetal organ, maintains the feto-maternal circulation via its connection: the umbilical cord [1]. A normally functioning placenta is critical for normal fetal growth and development [2,3]. The size of placenta increases during fetal growth period to allow it to carry out its vital functions [4]. If the fetal growth is compromised it is due to the abnormal functioning of the placenta which can be detected by the abnormal placental measurements [5].

Placental thickness is very much related to fetal development and may be a key in perinatal outcome. According to Sadler et al., (2004), at term placenta is approximately 3 cm thick and measures 15-25 cm in diameter [6]. A 'warning limit' of placental diameter of 18 cm and placental thickness of 2 cm at 36 weeks predicts low birth weight neonates [7]. Small placentas are associated with preeclampsia, chromosomal abnormalities, severe maternal diabetes mellitus, chronic fetal infections and intrauterine growth restriction [8]. The placentas over 4 cm thick at term have been observed in conditions like diabetes mellitus, perinatal infections, hydrops fetalis (both immune & non immune) [7]. The incidence of perinatal morbidity and mortality was considerably higher among gravida with thick placenta, related to higher rates of fetal anomalies and higher rates of both small for gestational age and large for gestational age neonates at term [9].

Thus, present study was planned to study the placental growth on ultrasonography in relation to gestational age and fetal outcome. This study will prove effective for

peripheral centers in India which do not have doppler and 3D ultrasound facilities.

MATERIAL AND METHODS

The present study was a prospective observational longitudinal study conducted in the Department of Obstetrics and Gyanecology in collaboration with the Departments of Radio diagnosis and Pediatrics in Kasturba Hospital, BHEL Bhopal, between April 2012 and April 2013. Study was started after hospital ethical committee approval. 100 pregnant patients, who were sure of dates and willing to participate in study (after taking written consent) were recruited from ANC clinic at 24 weeks and were followed up at 32 weeks, 36 weeks and after delivery.

Inclusion Criteria

(1) Known last menstrual period (2)Singleton pregnancy (3)Age group of 20 - 35 years (4)Normal BMI (5) 24 weeks gestation.

Exclusion Criteria

(1) Patients who are not sure of dates or with history of irregular cycles (2) Previous LSCS (3)Chronic medical diseases like diabetes, hypertension, chronic renal disease (4) Obese females (5) Multiple pregnancy (6) Congenital anomaly in fetus (7) Low lying placenta or placenta previa (8) Difference >4 weeks between period of amenorrhea and fundal height.

OBSTETRIC ULTRASOUND

After completing the PNDT formalities, ultrasound was performed on LOGIC Q HDI 4000 machine using a 3.5 MHz curvilinear transducer. The fetus was observed for viability and gross anatomical defects and gestational age was estimated using various growth parameters:- Biparietal Diameter (BD), Femur Length (FL), Abdominal Circumference (AC), Head Circumference (HC). Placenta was localized in a longitudinal section. Placental thickness was taken at 24, 32 and 36 weeks.

The placental thickness was measured at the level of umbilical cord insertion in longitudinal direction from the lateral chorionic plate to the cord insertion excluding the retro placental area, to the precision of 1 mm. Umbilical artery color Doppler was used for further reconfirmation of the site of umbilical cord insertion. Placental grading according to Grannum's scale was also done [10].

Grade 0: Placental body is homogeneous.

Grade I: Placental body shows a few echogenic densities ranging from 2-4 mm in diameter.

Grade II: Chorionic plate shows marked indentations, creating comma-like densities which extend into the placental substance but do not reach the basal plate. Grade III: Complete indentations of chorionic plate through to the basilar plate creating, cotyledons, (portions of placenta separated by the indentations).

STATISTICAL ANALYSIS

Mean and standard deviation were used to summarize continuous maternal variables. Proportion and percentages were used for categorical variables. Pearson's Correlation analysis [11] and the p values were calculated by the 2-tailed significance.

RESULTS

In our study at 24 weeks gestation fetal parameters as BPD [Table/Fig-1a], FL [Table/Fig-1b], and AC [Table/Fig-1c] shows large positive correlation between placental thickness [Table/Fig-1d,e]. Mean placental thickness of 24.5 mm is the same as the gestational age in weeks i.e. 24 weeks and can be useful in estimation of gestational age [Table/Fig-2]. There is also large positive correlation between placental thickness at 32 weeks of gestation with biometric parameters on ultrasound. Mean placental thickness of 31.8 mm is the same as the gestational age in weeks i.e. 32 weeks and can be useful in estimation of gestational age. [Table/Fig-3] At 36 weeks gestation again there is large positive correlation between placental thickness with biometric parameters on ultrasound. As Mean placental thickness of 35.5 mm is the same as the gestational age in weeks i.e. 36 weeks and can be useful in estimation of gestational age [Table/Fig-4]. So, there was linear increase of placental thickness at 24, 32 & 36 weeks [Table/Fig-5].

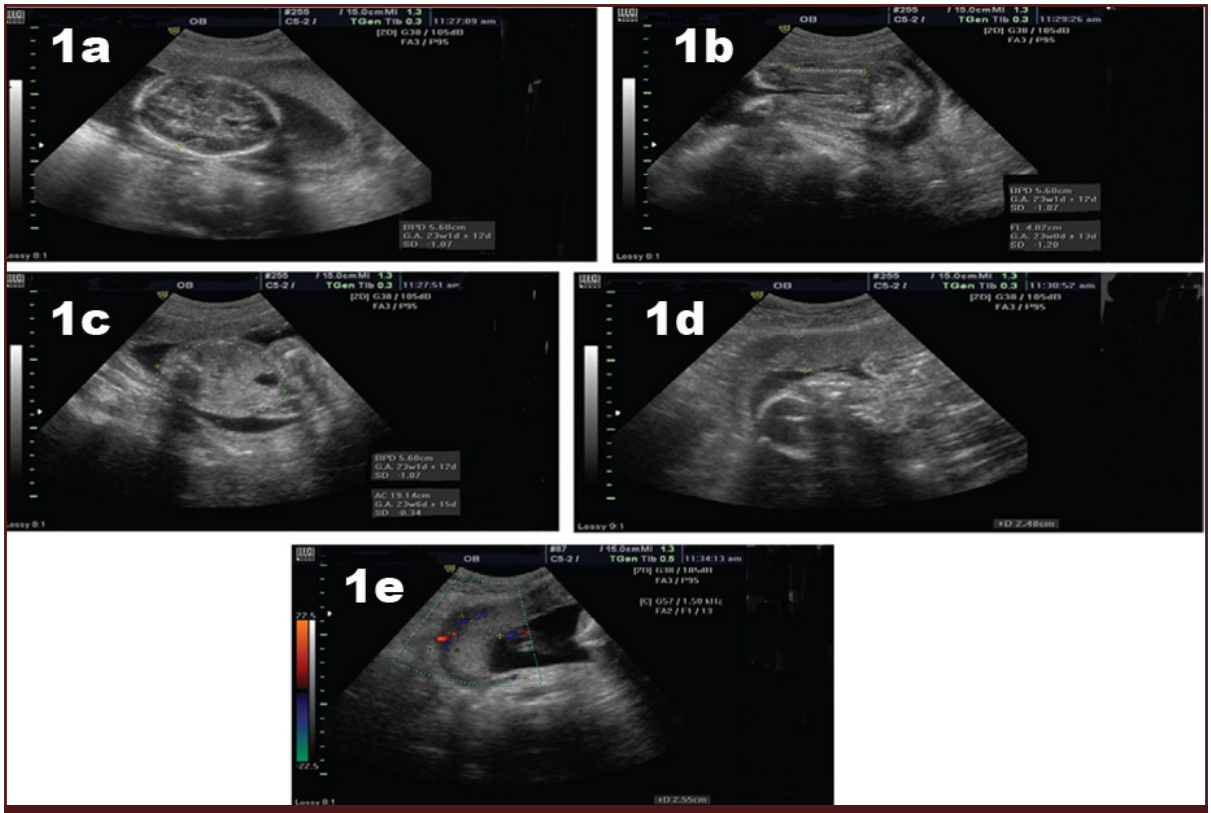
In our study placental thickness on ultrasound, at 32 weeks had significant positive correlation with estimated fetal weight and birth weight. (r= 0.405 and p= 0.000) [Table/Fig-6]. It also shows that estimated fetal weight and birth weight increase with placental thickness at 36 weeks. (r= 0.740 and p= 0.000) [Table/Fig-7].

At 24 weeks, one patient who was suspected to have IUGR by biometric parameters had placental thickness below 10th percentile at 24 and 32 weeks and gave birth to a low birth weight neonate. At 32 weeks, all of the 7 patients (*this includes 1 patient with IUGR at 24 weeks) who were suspected to have IUGR by biometric parameters had placental thickness below 10th percentile at 32 and 36 weeks and 57% (4/7) had meconium stained liquor. 10 patients (#This incudes 7 patients with suspected IUGR at 32 weeks) were suspected to have IUGR by biometric parameters at 36 weeks. 80% (8/10) had placental thickness a below 10th percentile at 36 weeks [Table/Fig-8].

DISCUSSION

A genuinely straight increment in mean placental thickness with gestational age was seen in previous relationship investigational studies, which has led to focus our study on the relationship between placental thickness and gestational age.

The estimation that mean placental thickness increments with progressing gestational age, from the 22nd to the 35th week and 27th to 33rd weeks, were found in two



[Table/Fig-1a]: Shows BPD of subject no. 31 at 24 weeks. The BPD is 23 wks +1 day
[Table/Fig-1b]: Shows FL of subject no. 31 at 24 weeks. The FL is 23 wks
[Table/Fig-1c]: Shows AC of the subject no. 31 at 24 weeks. The AC is 23 wks+6 days
[Table/Fig-1d]: Shows Placental thickness of the subject no. 31 at 24 weeks. The Placental thickness is 24.8 mm. which correlated with gestational age and biometric parameters
[Table/Fig-1e]: Shows role of colour Doppler in confirming site of insertion of umbilical cord. The Placental thickness is reconfirmed to be 25.5mm with colour Doppler mode

	BPD at 24 weeks (in wks)	FL at 24 weeks (in wks)	HC at 24 weeks (in wks)	AC at 24 weeks (in wks)	Composite gestational Age by US at 24 weeks	Placental thickness At 24 weeks (in mm)
Mean	24.35	24	24.1	23.7	24	24.5
Median	24.2	24.05	24	23.5	24	24.5
Mean±SD	24.3±0.8	24±0.7	24±0.8	23.7±0.8	24±0.4	24.5±0.75
Pearson's Correlation Coefficient (r)	0.52	0.53	0.6	0.52	0.62	

[Table/Fig-2]: Correlation between placental thickness at 24 weeks gestation with biometric parameters

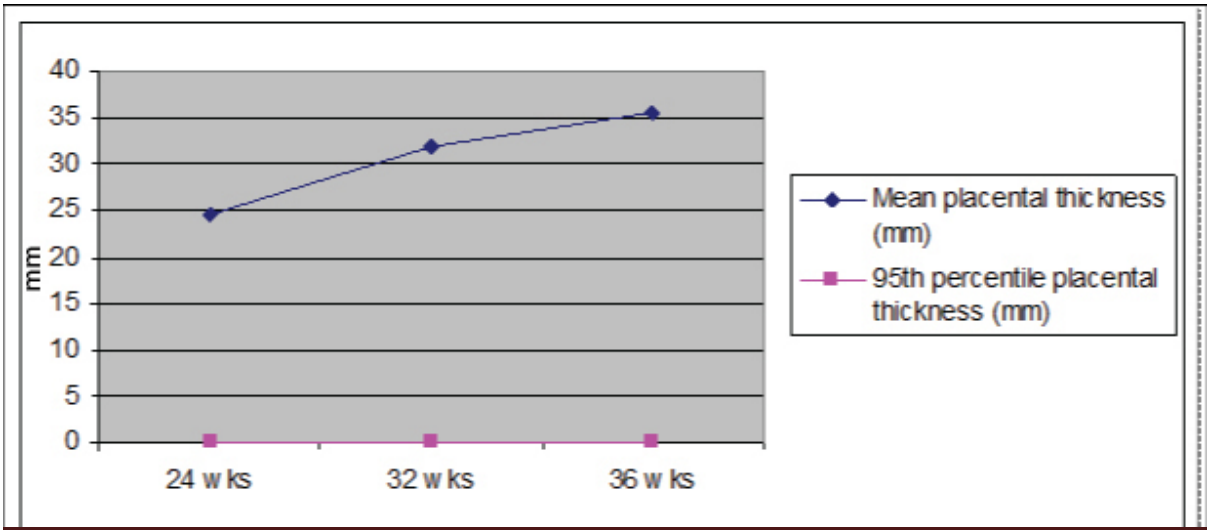
	BPD at 32 weeks (in wks)	FL at 32 weeks (in wks)	HC at 32 weeks (in wks)	AC at 32 weeks (in wks)	Composite gestational Age by US at 32 weeks	Placental thickness At 32 weeks (in mm)
Mean	31.9	31.7	31.8	31.2	31.7	31.8
Median	32	31.9	31.9	31.4	31.7	32.05
Mean±SD	31.9.±0.8	31.7±0.8	31.9±0.8	31.2±1.1	31.7±0.15	31.8±1.6
Pearson's Correlation Coefficient (r)	0.61	0.623	0.63	0.686	0.67	

[Table/Fig-3]: Correlation between placental thickness at 32 weeks gestation with biometric parameters

different studies led in India and was consistent with our study [10,11]. Our study depicts mean placental thickness 24.5 mm at 24 weeks, 31.8 mm at 32 weeks and 35.5 mm at 36 weeks. So, placental thickness in millimeters almost coincides with gestational age in weeks at 24 weeks (24.5 mm at 24 weeks), 32 (31.8 mm at 32 weeks) and 36 weeks (35.5 mm at 36 weeks). It suggests a strong positive correlation between placental thickness and biometric parameters at 24, 32 and 36 weeks.

	BPD at 36 weeks (in wks)	FL at 36 weeks (in wks)	HC at 36 weeks (in wks)	AC at 36 weeks (in wks)	Composite gestational Age by US at 36 weeks	Placental thickness At 36 weeks (in mm)
Mean	35.6	35.4	35.4	34.6	35.3	35.5
Median	35.7	35.5	35.5	35	35.5	35.7
Mean±SD	35.6.±1.0	35.4±1.1	35.4±1.2	34.6±1.8	35.3±1.21	35.5±2.77
Pearson's Correlation Coefficient (r)	0.65	0.69	0.65	0.76	0.735	

[Table/Fig-4]: Correlation between placental thickness at 36 weeks with biometric parameters



[Table/Fig-5]: Linear increase of placental thickness at 24, 32 and 36 weeks

Placental thickness at 32 Wks	No. of patients (n=100)	Mean estimated fetal weight (in kg)	Birth weight <2.5 kg	Birth weight >2.5 kg
≤29.5 mm	10	1.56	7	3
29.6 -34.5 mm	85	1.81	10	75
≥34.6 mm	5	2.24	1	4

[Table/Fig-6]: Correlation between placental thickness at 32 weeks with estimated fetal weight and birth weight of the neonate

Placental thickness at 36 Wks	No. of patients (n=97)	Mean estimated fetal weight (in kg)	Birth weight <2.5 kg	Birth weight >2.5 kg
27.1-31.5 mm	12	1.90	10	2
31.6 – 39.5mm	80	2.21	4	76
39.6 – 44.0 mm	5	2.45	1	4

[Table/Fig-7]: Correlation between placental thickness at 36 weeks with estimated fetal weight & birth weight of the neonate
*Out of the 100 patients, 3 had a preterm vaginal delivery. Fetal biometric parameters BPD, FL, HC, AC were measured at 36 weeks in remaining 97 patients

Comparable study by T Karthikeyan et al., moreover communicates 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 test sizes 32, 89 and 90 respectively, there was an increment, in the placental thickness with the gestational age [12]. Khatri et al., finished up like our study that the placental thickness increases from 16mm at 12 weeks to 39mm at 40 weeks. The estimation of the placental thickness is an essential parameter for determination of fetal age along with other parameters particularly in the late mid trimester and early third trimester where the span of pregnancy is not known [13].

The mean estimated fetal weight in those with placental thickness below 10th percentile at 36 weeks was 1.92 kg. 80 % patients detected to have thin placenta (thickness below 10th percentile) at 32 and 36 weeks, had produced low birth weight neonates whereas only 5% of those with placental thickness above 10th percentile produced low birth weight neonates. Therefore our study showed that placental thickness below the 10th percentile was associated with IUGR and significantly more number of low birth weight neonates. Ohagwu et al., (2009) found that there was critical positive association between

Gestational age	Total no. of patients	Patient ID no.	Placental thickness in mm and placental diameter in cm			Meconium stained liquor	Birth weight of baby	Apgar score	NICU Admission
			Placental thickness at 24 wks in mm	Placental thickness at 32 wks in mm	Placental thickness at 32 wks in mm				
24 wks	1	22	22	29.7	31	No	2.3	8	No
32 wks	7*	16	22	27.5	30.4	Yes	2.25	3	Yes
		30	24.5	28.6	29.5	Yes	1.9	3	Yes
		53	23.4	29.2	31.5	No	2.3	8	No
		56	20.1	27.4	29.9	Yes	2.0	4	Yes
		59	22.2	28.4	30.2	Yes	2.1	4	Yes
		99	22.4	28.1	30	No	2.1	8	No
36 wks	10#	36	23.4	31.4	32	Yes	2.2	4	Yes
		62	21.6	30.4	32	Yes	2.2	3	Yes
		89	22.4	28.4	30.5	Yes	2.3	3	Yes

[Table/Fig-8]: Placental thickness and fetal outcome in patients predicted to have IUGR by biometric parameters
*this includes 1 patient with IUGR at 24 weeks
#This incudes 7 patients with suspected IUGR at 32 weeks

placental thickness and evaluated fetal weight in the second trimester and third trimesters [4].

Habib et al., (2002) observed that a placental thickness of less than 2 cm at 36 weeks' gestation could be highly sensitive cut-off points for detecting LBW neonates [7]. The main drawback of the study was that serial fetal and placental measurements were not performed in the study because of the poor attendance of the patients [7] .The study suggested that retardation of placental growth precedes fetal growth retardation.

The placenta and its adjustment to anomalous conditions are imperative to fetal development. Kulman and Warsoff expressed that a PT of < 25 mm at term, was related with Intra Uterine Growth Retardation (IUGR) [14]. A placental thickness of > 40mm at term was related with gestational diabetes, intra uterine contaminations and hydrops foetalis [15]. Habib et al., in their study, said that the placental thickness was 22mm at 36 weeks in the babies which measured <2500gm and that the placental thickness was 34.8mm at 36 weeks in the hatchlings which measured > 2500gm. They presumed that placental thickness was an indicator of LBW infants [7].

In our study, the mean placental thickness at 36 weeks was 35.5mm. Here, placental thickness below 10th percentile at 32 and 36 weeks could detect IUGR with a sensitivity of 53.5%, specificivity of 92 % and positive predictive value of 80%. This shows that placental thickness is an excellent parameter in predicting IUGR. From the above discourse, it is obvious that a diminished placental thickness is related with IUGR. Along these lines, we conclude that subnormal placental thickness should be taken as earliest marker of IUGR.

CONCLUSION

There is increase in Placental thickness almost linearly with gestational age between 24, 32 and 36 weeks. So, measurement of the placental thickness is a significant parameter for estimation of fetal age along with other parameters particularly in the late mid trimester and early third trimester where the exact duration of pregnancy is not known. Thin placenta < 29 mm at 32 weeks and <31 mm at 36 weeks were associated with increased morbidity, poor Apgar scores and higher incidence of nursery admission. So, patients within this parameter should deliver in places having good nursery facilities. Measurement of placental parameters are effective for peripheral centers in India which do not have Doppler and 3D ultrasound facilities for timely referral and safe outcome of fetus.

LIMITATIONS

Using a two-dimensional ultrasound to obtain the thickness, and diameter of the placenta and calculating the volume would have introduced errors. This is because such calculations would be based on the formula for calculating the volume of a sphere which the placenta approximates to in shape.

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