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New Fetal Independent Parameters for Estimating Gestational Age – Placental Thickness and Placental Tapering Angle

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Abstract: ***The aim of the study was to investigate the relationship of placental thickness and placental tapering angle with gestational age and fetal growth parameters in normal singleton pregnancies. 138 pregnant women with gestational age from 13 to 36 weeks without any fetal or maternal complications were studied by ultrasound in a cross sectional prospective study at a tertiary level hospital in Surat. Ultrasound was performed and composite gestational age was determined by measuring routine fetal biometric parameters. Placental thickness was measured at the level of umbilical cord insertion, from echogenic chorionic plate to placental myometrial interface. Placental tapering angle was measured by drawing one line at placental-myometrial interface and another line at fetal surface of the placenta, and measuring angle between two lines. Relationship of placental thickness and placental tapering angle with gestational age was investigated by Pearson's correlation analysis. Statistical tests were two-tailed with p< 0.01 to indicate statistical significance. The study showed that placental thickness and placental tapering angle have positive correlation with gestational age.***

Keywords: Placental thickness, Placental angle, Gestational age, Fetal growth.

1. Introduction

The placenta is a highly vascular fetal organ which 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].

The size of placenta increases during fetal growth period to allow it to carry out its vital functions [3]. 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 [4].Total placental volume is probably most accurate placental measurement, but it is too complicated and cumbersome for routine use. Placental thickness and placental angle can reflect overall growth of the placenta and is relatively simple to measure. According to Sadler et al., (2004), at term placenta is approximately 3 cm thick and measures 15-25 cm in diameter [5]. A 'warning limit' of placental diameter of 18 cm and placental thickness of 2 cm at 36 weeks predicts low birth weight neonates [6].

Small placentas are associated with preeclampsia, chromosomal abnormalities, severe maternal diabetes mellitus, chronic fetal infections and intrauterine growth restriction [7]. The placentas over 4 cm thick at term have been observed in conditions like diabetes mellitus, perinatal infections, hydrops fetalis (both immune & non immune). 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 [8].

2. Aims and Objectives

Present study was aimed to evaluate the relationship of the placental thickness and placental angle with gestational age and fetal outcome on ultrasonography.

3. Materials and Method

The present study was a prospective observational longitudinal study conducted in the Department of Radio diagnosis at a tertiary level hospital in Surat. 138 pregnant patients with gestational age from 13 to 36 weeks without any fetal or maternal complications who were referred for routine antenatal ultrasound were included in the study after taking written consent.

Inclusion Criteria

1) Viable normal singleton pregnancy, 13-36 weeks
2) Known last menstrual period
3) Age group of 20 - 35 years

Exclusion Criteria

1) Patients who are not sure of LMP
2) Chronic medical diseases like diabetes, hypertension, chronic renal disease
3) Multiple pregnancy
4) Congenital anomaly in fetus
5) Low lying placenta or placenta previa
6) Previous LSCS

After completing the PCPNDT formalities, ultrasound was performed on GE Volusion S8 machine using a 3.5 MHz curvilinear transducer. The fetus was observed for viability

and gross anatomical defects. The composite gestational age was determined by measuring the Biparietal Diameter (BPD), Abdominal Circumference (AC), Head Circumference (HC) and Femur Length (FL). Placental localisation was done. Placental thickness was measured at the level of umbilical cord insertion site from the echogenic chorionic plate to placental myometrial interface, perpendicular to the uterine wall with placenta localized in longitudinal section. Umbilical artery color Doppler was used for the confirmation of the site of umbilical cord insertion. For measurement of Placental angle, one line was drawn at the placental myometrial interface and another line drawn at the fetal surface of placenta intersecting the first line, at the least tapering edge of placenta with placenta localized in longitudinal section and angle between these two lines was measured.

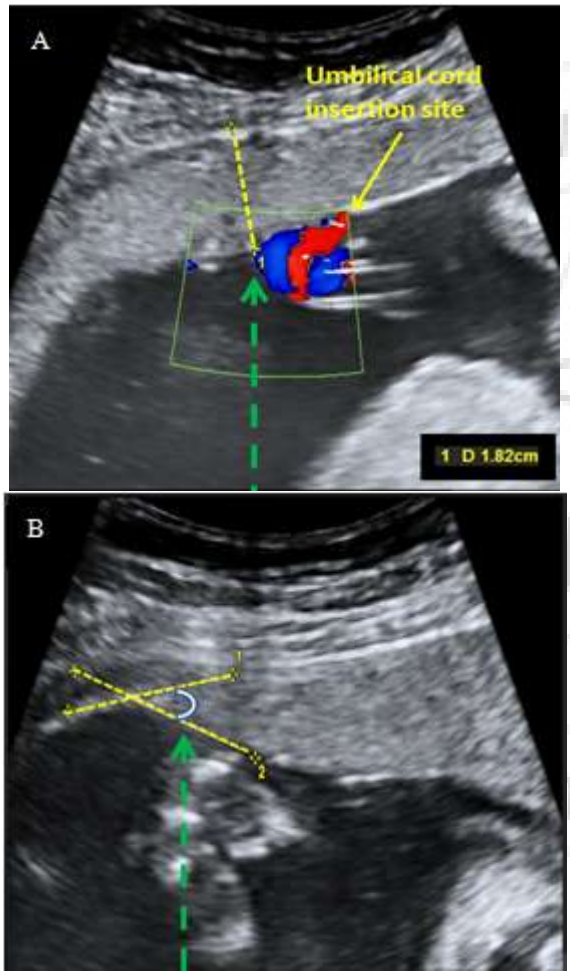

Figure 1: (A) Measurement of Placental Thickness. (B) Measurement of Placental Tapering Angle.

Placental grading according to Grannum's scale was also done [9].

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).

4. Statistical Analysis and Results

Distribution of 138 patients was done amongst various groups according to the age [Table-1], placental maturation grade [Table-2] and gestational age [Table-3]. According to the gestational age, 6 groups were categorized and mean with standard deviation was calculated for placental thickness and placental angle for each group. From [Table-3] it is evident that placental thickness and placental angle increase with the gestational age and both of these are gestational age dependent variables.

Table 1: Distribution of the maternal age

Age in years	Number of cases (n)	Percentage (%)
20-25	67	48.5 %
26-30	45	32.7 %
31-35	26	18.8 %
Total	n=138	100 %

Table 2: Distribution according to the placental maturation grade

Placental Maturation Grade	Number of cases (n)	Percentage (%)
Grade I	51	36.9 %
Grade II	70	50.7 %
Grade III	17	12.4 %
Total	n=138	100 %

Table 3: Distribution of the gestational age, mean values of placental thickness and placental angle

Gestational age in weeks	Number of Cases (n)	Placental Thickness in mm (Mean± SD)	Placental Angle (Mean ± SD)
13 - 16	23	16.33±1.15	19.78±3.52
17 - 20	19	21.20±3.43	22.42±3.13
21 - 24	26	23.65±4.30	25.65±2.59
25 - 28	22	31.42±4.47	29.32±3.83
29 - 32	23	33.82±4.41	32.68±4.25
33 - 36	25	37.29±3.97	38.43±2.74

Relationship of placental thickness and placental tapering angle with composite gestational age was investigated by Pearson's correlation analysis. Value of correlation coefficient (r) for placental thickness and gesational age was 0.846 which indicates very strong positive correlation. Value of Correlation coefficient (r) for placental tapering angle and gesational age was 0.635 which indicates moderate positive correlation. P - value was 0.003 and 0.005 respectively. Thus, for both the variables p value was < 0.01 indicating that the correlation is statistically significance.

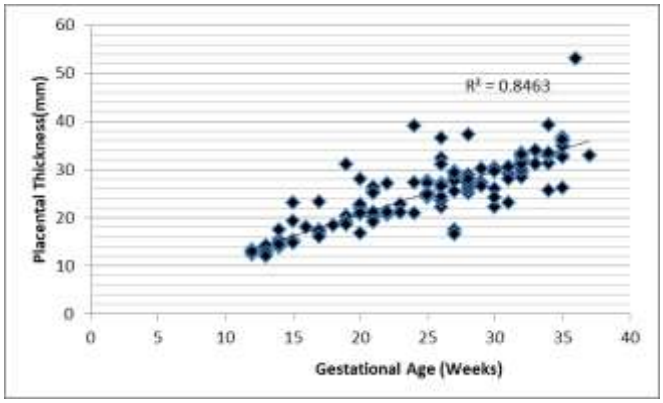

Figure 2: Correlation values distribution between Placental thickness & gestational age in 138 patients.

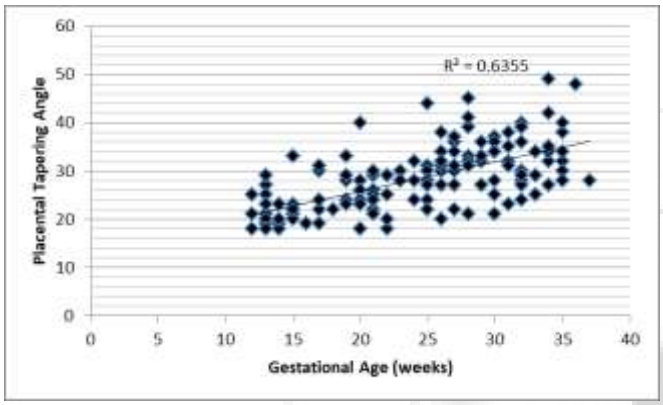

Figure 3: Correlation values distribution between Placental tapering angle & gestational age in 138 patients.

5. Discussion

The placenta is a very vascular fetal organ which main function is to exchange nutrients and metabolic products and gases between the maternal and fetal blood streams. The size of the placenta increases during the fetal growth period to enable it performs its vital functions. As the embryo grows and develops a vascular system, it must establish a much more efficient means of obtaining nutrients and eliminating waste products, and does so by establishing an efficient interface between its vascular system and that of its mother. That interface is the placenta. In addition to its primary goal of facilitating transport between mother and fetus, the placenta is also a major endocrine organ.

Our study showed a statistically significant strong positive correlation between placental thickness and gestational age & moderate positive correlation between placental angle and gestational age. The result of our study showed that placental thickness and placental angle increase with gestational age in a fairly linear manner. This relationship suggests that placental thickness and placental angle can be used as an indicator of gestational age.

Kulman and Warsoff stated that a placental thickness of < 25 mm at term, was associated with Intra Uterine Growth Retardation (IUGR) [9]. A placental thickness of > 40mm at term is associated with gestational diabetes, intra uterine infections and hydrops fetalis [10]. 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 [11]. The incidence of the perinatal mortality and the fetal anomalies were greater in the subjects with thick placentas [6].

Figure 4: Patient with gestational age of 20 weeks 2 days (A) Placental Thickness was 20.7 mm. (B) Placental Tapering Angle was 24^0.

From the above discussion, it is evident that a decreased placental thickness is associated with IUGR. So, a subnormal placental thickness 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 placental thickness is > 40 mm at term and if it is associated with gestational Diabetes mellitus, intra uterine infections, hydrops fetalis, anaemia and α- thalassaemia type [12]. So, an increased placental thickness for that GA should raise a suspicion about the possible disease conditions.

This study was in accordance with several other studies in this regards [1,3,7]. To best of our knowledge, role of least marginal angle of placenta in estimation of gestational age has not been reported till date. In our study placental tapering angle showed moderate positive correlation with gestational age.

The usefulness of this relationship of placental thickness and placental angle with growth parameters is that subnormal placental thickness for a gestational age may be the earliest indication of fetal growth retardation. When a thin placenta is observed fetal weight should be estimated and possible medical intervention undertaken if the fetal weight is below the normal value. So, the substitution of any abnormal fetal parameters like BPD in hydrocephalus with PT in USG, in the GA estimation, can be ventured into.

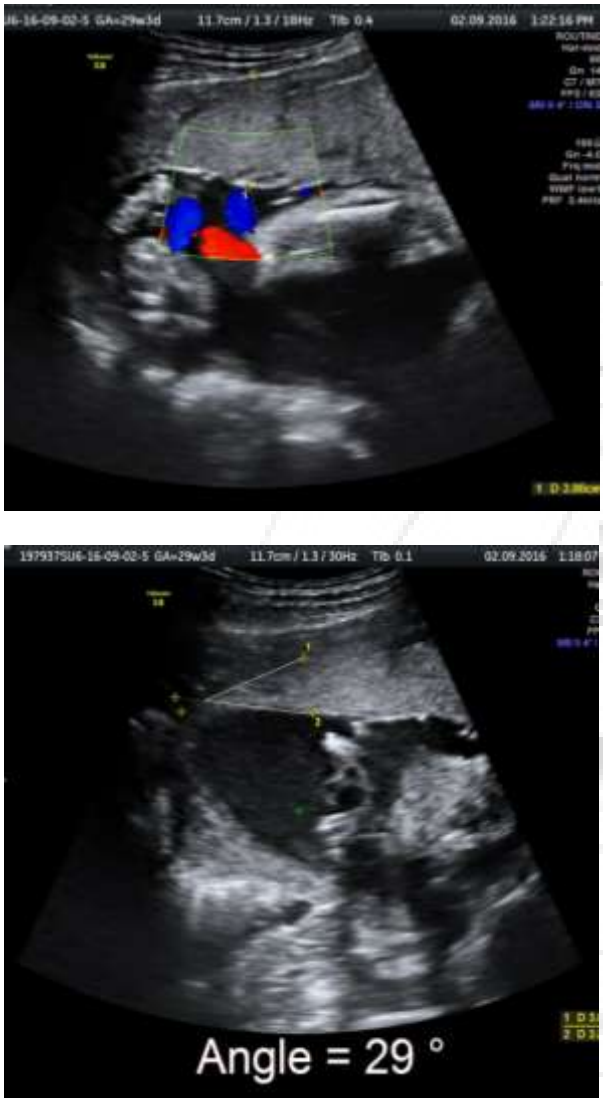

Figure 5: In patient with gestational age of 29 weeks 3 days (A) Placental Thickness was 30 mm. (B) Placental Tapering Angle was 29^0.

In this study we adopted a cross sectional design and did not follow the patients longitudinally. There is a need to recruit subjects at the beginning of the second trimester and scan them at regular intervals to ascertain the relationship between placental thickness and growth parameters. Such a study should be multiple to increase the validity of the result.

6. Conclusion

From our study it is evident that placental tapering angle and placental thickness can serve as additional parameters for determining gestational age when duration of pregnancy is uncertain or they can substitute for any compromised fetal parameters like Biparietal diameter (BPD) in hydrocephalus. We conclude that the role of placental tapering angle and placental thickness in estimation of fetal gestational age appears promising and can be integrated as part of antenatal ultrasound.

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