

Full Length Research Paper

Relationship between placental thickness and growth parameters in normal Nigerian fetuses

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To investigate the relationship between placental thickness and foetal growth parameters in normal singleton Nigerian fetuses. Six hundred and sixty-six pregnant Nigerian women were studied by ultrasound in a cross sectional prospective study at the Federal Medical Centre, Makurdi, Nigeria. The pregnancies were in the second and third trimesters, and were not complicated by either maternal or foetal disease. BPD and AC were measured, and the placental thickness was measured at the insertion of the umbilical cord. A nomogram of placental thickness was formulated while the relationship between placental thickness and, BPD and AC was investigated by Pearson's correlation analysis. Mathematical relationships between placental thickness and, BPD and AC were derived by regression analysis. Values were expressed as mean \pm standard deviation. Statistical tests were two-tailed with $p < 0.01$ to indicate statistical significance. The maximum mean placental thickness of 45.09 ± 6.37 mm was recorded at 39 week of gestation. There was a fairly linear increase in placental thickness with gestational age. There was significant positive correlation between placental thickness and, BPD and AC in the second and third trimesters with both parameters having identical relationship with placental thickness. Placental thickness has a strong positive correlation with BPD and AC. Subnormal placental thickness for a particular gestational age may be the earliest sign of intrauterine growth retardation. Measurement of placental thickness should therefore be carried out routinely during obstetrics ultrasound scan.

Key words: Placental thickness, foetal growth parameters, ultrasound, singleton fetuses, Nigerian women.

INTRODUCTION

At term, the placenta is discoid with a diameter of 15 to 25 cm and is approximately 3 cm thick and weighs about 500 to 600 g (Sadler, 2004). Placental thickness increases with age of the foetus (Hoddick et al., 1984; Jauniaux et al., 1994; Tongsong and Boonyanurak, 2004; Mital et al., 2002; Anupama et al., 2001). Placenta is a highly vascular foetal organ which maintains the maternal-foetal circulation via its connection by the umbilical cord. Amongst its functions are exchange of metabolic and gaseous product between maternal and foetal blood streams and production of hormones (Sadler, 2004). One of the hormones produced by the placenta is

the growth hormone- like substance somatomammotropin (Sadler, 2004).

Foetal growth parameters such as biparietal diameter (BPD) and abdominal circumference (AC) are used in the sonographic estimation of gestational age and weight of the foetus in the second and third trimesters. Femur length has been established as an accurate parameter for estimating gestational age in the second and third trimesters (Ziylan and Murshid, 2003) while foetal weight can be estimated by Sheppard's method using only BPD and AC with a deviation of 295 g from the actual birth weight (Hebbar, 2003). These growth parameters are adversely affected by insufficient nutrients reaching the foetus through the placenta. In these fetuses the placental is often thin. A placental thickness of less than 2.5 cm is usually associated with intrauterine growth retardation (IUGR) (Kunlmann and Warsof, 1996).

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We think that placental thickness should have a certain relationship with foetal growth parameters especially BPD and AC. The aim of our study was to investigate this relationship in normal singleton Nigerian fetuses. To the best of our knowledge no such studies have been carried out in this aspect of obstetric ultrasonography in our locality.

MATERIALS AND METHODS

This cross sectional prospective study was conducted in the Department of Radiology and Department of Obstetrics and Gynaecology, Federal Medical Centre, Makurdi Benue State, Nigeria. A total of 666 Nigerian women in the second and third trimesters of pregnancies were selected for the study. All the women were attending antenatal clinic with viable singleton and uncomplicated pregnancies. Patients with pregnancy induced hypertension (PIH), diabetes mellitus, history of previous intrauterine growth retardation (IUGR), hydrops foetalis, congenital malformation, twin gestation, hydroamniotic and placental anomalies were excluded from the study. Patients who did not know their last menstrual period (LMP) were also excluded from the study.

Sonography was carried out on each patient included in the study using Toshiba SSA 250 Sonolayer ultrasound equipment with a 3.75 MHz curvilinear transducer. The foetus was observed for viability and congenital anatomical defects, and gestational age estimated using various growth parameters. The growth parameters used in estimating gestational age were BPD and FL in the second trimester and BPD, FL and AC in the third trimester. The composite average of the gestational ages estimated by the various growth parameters was taken for each foetus.

The placenta was localized in a longitudinal section. The placental thickness was then measured near the insertion of the umbilical cord.

Statistical analysis

Analysis was done on computer using the Microsoft statistical package, SPSS 11.0. Descriptive statistics were used to formulate a nomogram of placental thickness. Pearson's correlation analysis was used to establish the degree of relationship between placental thickness and, BPD and AC. Mathematical relationships between placental thickness and, BPD and AC were derived by regression analysis while the best-fit method was used to plot the linear graphs of relationship between placental thickness and the growth parameters.

Values were expressed as mean \pm standard deviation. Statistical tests were two-tailed with $p < 0.01$ to indicate statistical significance.

RESULTS

The results of our study showed that there was a fairly linear increase in placental thickness with gestational age as shown in Table 1. The maximum mean placental thickness of 45.09 ± 6.37 mm was recorded at 39 week of gestation as shown in Table 1.

There was a significant positive correlation between placental thickness and, BPD and AC in the second and third trimesters; with both parameters having identical relationship with placental thickness as shown in Table 2.

Regression analyses yielded the following linear mathematical relationships between BPD and AC, and placental thickness in the second and third trimesters:

$$y[\text{BPD}(\text{mm})] = 1.302 (\text{placental thickness}(\text{mm})) \pm 15.366 \quad (1)$$

($r = 0.626$) in the second trimester.

$$y[\text{AC}(\text{mm})] = 5.3435 (\text{placental thickness}(\text{mm})) \pm 20.226 \quad (2)$$

($r = 0.626$) in the second trimester.

$$y[\text{BPD}(\text{mm})] = 0.6853 (\text{placental thickness}(\text{mm})) \pm 56.988 \quad (3)$$

($r = 0.522$) in the third trimester.

$$y[\text{AC}(\text{mm})] = 3.3854 (\text{placental thickness}(\text{mm})) \pm 263.49 \quad (4)$$

($r = 0.523$) in the third trimester.

These equations are shown in the graphs in the Figures 1, 2, 3 and 4.

DISCUSSION

The placenta is a very vascular foetal organ which main function is to exchange nutrients and metabolic products and gases between the maternal and foetal blood streams. The size of the placenta increases during the foetal growth period to enable it perform 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. In almost all mammals the placenta synthesizes and secretes steroid hormones - progesterone and estrogens. The placenta also produces a number of protein hormones. Depending on the species, it is the source of chorionic gonadotropins, relaxin, and placental lactogens. Placental hormones have profound effects on both fetal and maternal physiology. Despite the fact that all placentae carry out the same basic processes of transport and hormone secretion, there are important differences in structure and function among families of mammals. The placentae of humans, cattle, horses and dogs are all very different from one another at both gross and histologic levels. They also differ in certain functions that are clinically important - for example, in the ability to transport maternal immunoglobulins to the fetus (<http://www.vivo.colostate.edu/hbooks/pathphys/reprod/placenta>).

The result of our study showed that placental thickness increased with gestational age in a fairly linear manner. This relationship suggests that placental thickness can be

Table 1. Normal values of placental thickness in the second and third trimesters.

Second trimester		
EGA(weeks)	No of measurements	Placental thickness(mm)
14	10	18.33 ± 1.15
15	23	18.65 ± 3.68
16	27	21.96 ± 2.86
17	15	21.20 ± 3.43
18	15	23.67 ± 2.61
19	23	23.65 ± 4.30
20	17	25.41 ± 4.26
21	24	27.17 ± 4.88
22	16	28.63 ± 4.50
23	20	27.30 ± 3.28
24	12	28.92 ± 5.09
25	17	27.41 ± 5.21
26	25	32.52 ± 4.94
Third trimester		
27	24	31.42 ± 4.47
28	28	32.00 ± 4.36
29	28	33.82 ± 4.41
30	21	36.00 ± 5.39
31	31	36.81 ± 4.69
32	48	36.00 ± 5.63
33	27	37.00 ± 0.00
34	18	37.29 ± 3.97
35	37	41.08 ± 7.63
36	33	39.30 ± 7.11
37	31	43.52 ± 5.56
38	33	42.49 ± 5.79
39	35	45.09 ± 6.37
40	13	43.00 ± 5.29
41	15	43.40 ± 8.31
n = 666		

Table 2. Correlation between placental thickness and the growth parameters; biparietal diameter (BPD) and abdominal circumference (AC).

Pregnancy	BPD	AC
Second trimester (n = 244)	r = 0.626 p = 0.000*	r = 0.626 p = 0.000*
Third trimester (n = 422)	r = 0.522 p = 0.000*	r = 0.523 p = 0.000*

* = Significant.

used as an indicator of gestational age.

Our study showed a statistically significant positive correlation between placental thickness and, BPD and AC. This means that estimated foetal weight which is calculated based on a formula having BPD and AC as variables (Shepard et al., 1987) is dependent on placental thickness.

Placental thickness of less than 2.5 cm is associated with intrauterine growth retardation (Kunlmann and Warsof, 1996) while thick placentas are associated with maternal diabetes mellitus, foetal hydrops and intrauterine foetal infections. The usefulness of this relationship between placental thickness and growth parameters is that subnormal placental thickness for a gestational age may be the earliest indication of foetal growth retardation. When a thin placenta is observed foetal weight should be estimated and possible medical intervention undertaken if the foetal weight is below the normal value.

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. In our environment this will be a difficult task because of low literacy level.

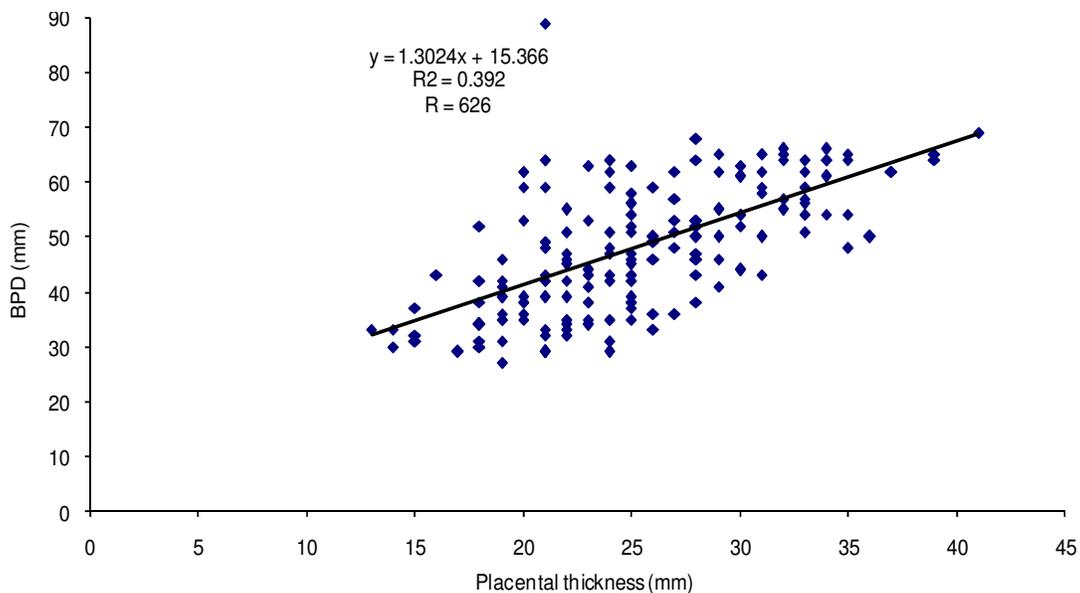


Figure 1. Graph of biparietal diameter (BPD) against placental thickness in the second trimester.

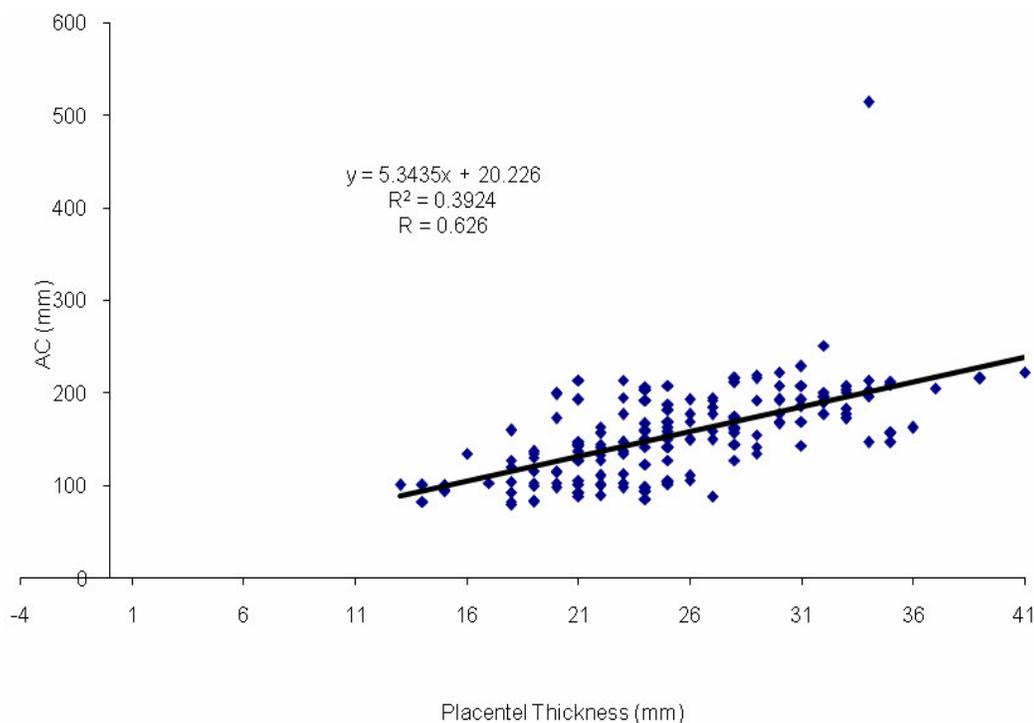


Figure 2. Graph of AC against placental thickness in the second trimester.

The mathematical relationships derived by regression analysis presented in equations 1, 2, 3, and 4 can be used to objectively reach a conclusion on the normality of placental thickness in relation to BPD and AC observed during obstetric scan.

Conclusion

Placental thickness has a strong positive correlation with BPD and AC; with both parameters having identical relationship with placental thickness. Subnormal placental

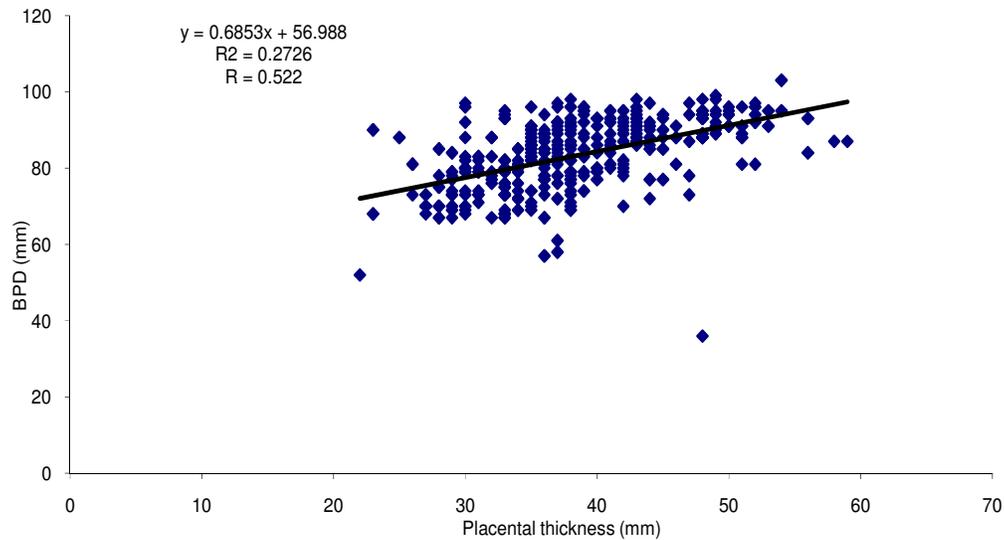


Figure 3. Graph of BPD against placental thickness in the third trimester.

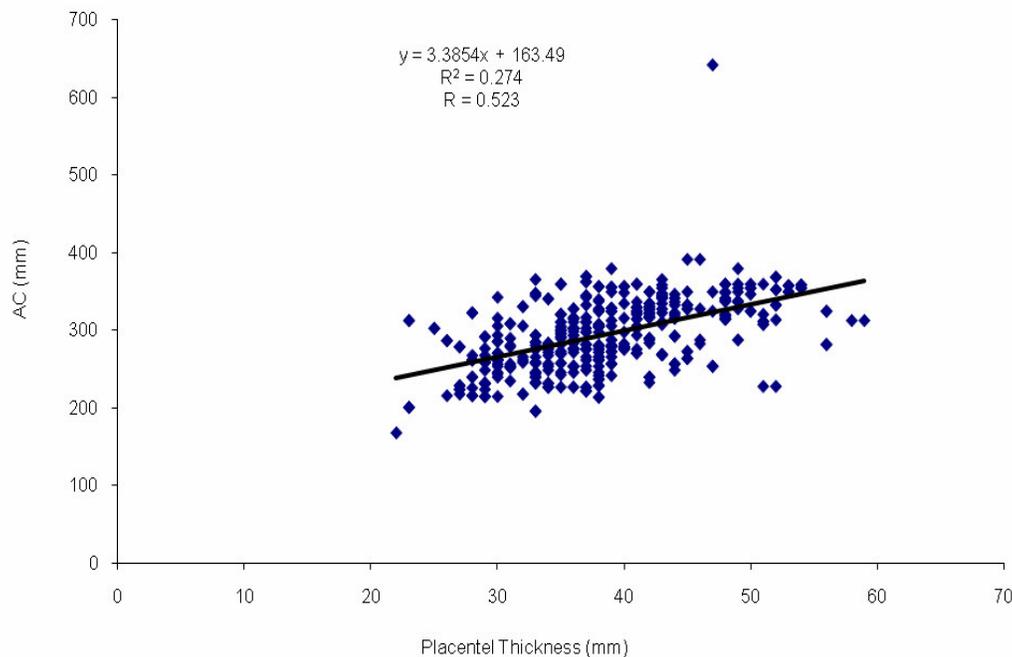


Figure 4. Graph of AC against placental thickness in the third trimester.

thickness for a particular gestational age may represent a sign of intrauterine growth retardation. We therefore recommend that measurement of placental thickness be routinely carried out during obstetric ultrasound scan.

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