

# Ultrasonographic measurement of placental thickness in third trimester and its correlation with estimated fetal weight and birth weight

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## Abstract

Background: Placenta may be referred to as the 'mirror of the perinatal period, which has not been sufficiently polished'. Adequate foetal growth depends on the efficient delivery of nutrients from the mother to the foetus via normally functioning utero- placental organ. Measurement of placental thickness is relatively simple and clinically useful. Abnormal thickness of placenta is well recognized as a diagnostic harbinger in a wide spectrum of pathologic events. Aims and objectives: To describe association of placental thickness with estimated fetal weight and actual birth weight. Result: There was a strong positive correlation between placental thickness and estimated fetal weight at different gestational age with  $p < 0.000$ . There was also strong positive correlation between placental thickness and actual birth weight of baby with  $p < 0.000$ . Conclusion: Ultrasonographic measurement of placental thickness in antenatal period can be effective, simple and non-invasive method of estimating fetal growth.

**Key Words:** Placenta, Placental thickness, Estimated fetal weight, Actual birth weight.

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## INTRODUCTION

Placenta (derived from a Greek word "plakuos")<sup>1</sup> is an extraordinarily complex and fascinating organ. No organ can match placenta for its diversity of functions because it performs the actions of all the major organ systems while these differentiate and mature in the foetus. Placenta may be referred to as the 'mirror of the perinatal period, which has not been sufficiently polished'. Placental function begins around 4<sup>th</sup> week of pregnancy with the formation of

the first anatomical elements necessary to ensure physiological exchanges.<sup>2</sup>

The placenta is formed by contributions from maternal as well as foetal elements.

Embryonic portion of the placenta consists of chorionfrondosum. Maternal portion is composed of decidua basalis.

Human placenta is hemochorial, discoid and deciduate<sup>3</sup>. At term, the placenta has a diameter of 15 to 25 cm and is approximately 3 cm thick and weighs about 500 to 600 gms<sup>4</sup>. Functions of placenta include:

- Nutritive function- Fetus is supplied with nutrients like amino acids, carbohydrates, free fatty acids and vitamins and the supply increases as the pregnancy advances.
- Excretory function- fetal metabolic wastes like urea, uric acid and creatinine are transferred to maternal blood by simple diffusion.
- Respiratory function- Exchange of gases like oxygen, carbon dioxide, carbon monoxide takes place by process of simple diffusion.

- D. Endocrine function- placenta produces steroid hormones and peptide hormones such as progesterone, somatomammotropin, relaxin and human chorionic gonadotrophin (hCG).<sup>5</sup> The major source of placental hormones is the syncytiotrophoblast layer.
- E. Barrier function- the fetal blood in villi and maternal blood in intervillous spaces, is separated by the placental barrier known as placental membrane.
- F. Immunologic function- placenta plays a fundamental role in the immunologic acceptance of the fetal allograft.<sup>6</sup>
- G. Enzymatic function- Various enzymes are elaborated in placenta like

Diamine oxidase, oxytocinase, phospholipase A<sub>2</sub>.

Adequate foetal growth and subsequent normal birth weight depends on the efficient delivery of nutrients from the mother to the foetus via normally functioning utero-placental organ.<sup>7</sup> Functional efficiency of placenta may be affected by different aspects of placental growth, which in turn will affect the birth weight of foetus as mass of placenta is translated into birth weight. The placenta enlarges throughout pregnancy with continuous growth of the foetus and expansion of the uterus. The increase in surface area of placenta parallels that of the expanding uterus and throughout the pregnancy it covers approximately 15 to 30% of the internal surface of the uterus. The increase in thickness of placenta results from arborization of existing villi and is not caused by further penetration into maternal tissue.<sup>4</sup> Placental thickness depends on the quantity of fetal blood, maternal blood and placental tissue.<sup>8</sup> So placental thickness is closely related to foetal wellbeing and may be a key factor in perinatal outcome. The definitive placenta is clearly visible on ultrasound from approximately 9–10 weeks of gestation, when it shows a uniformly granular echogenic pattern.<sup>9</sup> Sonography has provided a safe and non-invasive means to evaluate the placenta whose normal and abnormal size, appearance and growth pattern can have significant antenatal implications. The measurement of placental thickness is relatively simple and clinically useful. It is considered as the easiest placental dimension to measure<sup>10</sup>. Abnormal thickness of placenta is well recognized as a diagnostic harbinger in a wide spectrum of pathologic events. A 'warning limit' of placental diameter of 18 cm and placental thickness of 2 cm at 36 weeks predicts low birth weight neonates.<sup>11</sup> Studies have shown that diminished placental size precedes foetal growth

retardation as IUGR is associated with poor villous development and fetoplacental angiogenesis.<sup>12,13</sup> An excessively large placenta may be associated with infection, anaemia or triploidy.<sup>14</sup> Fetal weight estimates are important because a significant proportion of perinatal mortality is related to birthweight. Estimation of fetal weight can influence obstetric management decisions regarding the timing and route of delivery. The current study focuses on establishing the correlation between placental thickness and estimated fetal weight as well as the actual birth weight.

## MATERIAL AND METHODS

This prospective observational study was conducted in the Department of Obstetrics and Gynecology in ACPM Medical College from December 2018 to October 2020 on 100 pregnant women with singleton, uncomplicated pregnancy in 3<sup>rd</sup> trimester who were sure of their dates and consented to participate in the study after taking approval from the ethics committee. Patients were sent for ultrasound examination after taking informed and written consent. Ultrasonography done at 28 weeks, 32 weeks, 36 weeks, 38 weeks of gestation. Fetus was scanned for viability and congenital anatomical defects. Placental thickness was measured in mm trans-abdominally by placing ultrasound transducer perpendicular to the plane of placenta in the area of cord insertion near mid-placental portion at third trimester. The calculation of placental thickness was done from echogenic chorionic plate to placental myometrial interface. All placental measurements were taken during relaxed phase of uterus as contractions can spuriously increase placental thickness. The ultrasound machine formula for estimation of fetal weight was devised by Hadlock 4 basis of biparietal diameter, abdominal circumference, femoral length, head circumference. Actual birth weight was measured immediately after birth using a paediatric weight scale. The study subjects were selected based on following inclusion and exclusion criteria:

**INCLUSION CRITERIA:** All patients with singleton pregnancy. Patients with known LMP. Gestational age of  $\geq 28$  weeks up to 40 weeks.

**EXCLUSION CRITERIA:** Unknown LMP. Multiple pregnancies. Medical disorders like Diabetes, Hypertension. Patients in labour. Obesity. Rh incompatibility/ Fetal hydrops. Polyhydramnios/Oligohydramnios. Placenta praevia. Postdated. Fetal anomalies/ Uterine anomalies/Placental anomalies.

## RESULTS

In the total study group of 100 pregnant women, the age ranged between 18 years to 35 years. The mean age was 25.15. The distribution of cases with respect to maternal age are given in table 1.

**Table 1:** Maternal age distribution

| Age in years | Frequency  | Percentage   |
|--------------|------------|--------------|
| 18-25        | 54         | 54.0         |
| 25-30        | 40         | 40.0         |
| 30-35        | 6          | 6.0          |
| <b>Total</b> | <b>100</b> | <b>100.0</b> |

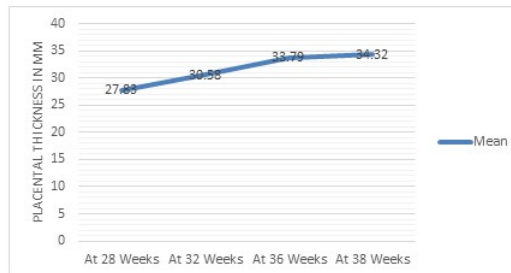
**Table 2:** Gravidity status distribution

| Gravidity    | Frequency | Percentage |
|--------------|-----------|------------|
| Primigravida | 52        | 52.0       |
| G2           | 34        | 34.0       |
| G3           | 11        | 11.0       |
| G4           | 3         | 3.0        |

Amongst the study group, 52% were primigravida whereas 48% were multigravidas.

**Table 3:** Descriptive statistics

| Parameter                        | Minimum | Maximum | Mean    | SD      |
|----------------------------------|---------|---------|---------|---------|
| Placental thickness @ 28 Weeks   | 25      | 29      | 27.83   | 1.100   |
| Placental thickness @ 32 Weeks   | 27      | 33      | 30.58   | 1.273   |
| Placental thickness @ 36 Weeks   | 29      | 36      | 33.79   | 1.667   |
| Placental thickness @ 38 Weeks   | 31      | 36      | 34.32   | 1.392   |
| Expected Fetal Weight @ 28 Weeks | 970     | 1368    | 1238.04 | 113.392 |
| Expected Fetal Weight @ 32 Weeks | 1200    | 1970    | 1794.23 | 152.756 |
| Expected Fetal Weight @ 36 Weeks | 1650    | 2734    | 2431.98 | 262.876 |
| Expected Fetal Weight @ 38 Weeks | 1900    | 3325    | 2866.54 | 352.984 |



**Graph 1:** Placental thickness at different gestational age **Graph 2:** Estimated fetal weight at different gestational age.

**Table 4:** Correlation between placental thickness (mm) and estimated fetal weight (grams).

| Gestational age (weeks) | Placental Thickness |       |      | Estimated Fetal Weight |         |        | Pearson's Correlation | P Value |
|-------------------------|---------------------|-------|------|------------------------|---------|--------|-----------------------|---------|
|                         | Range               | Mean  | SD   | Range                  | Mean    | SD     |                       |         |
| 28                      | 25-29               | 27.83 | 1.1  | 970-1368               | 1238.04 | 113.39 | 0.988**               | 0.000   |
| 32                      | 27-33               | 30.58 | 1.27 | 1200-1970              | 1794.23 | 152.75 | 0.898**               | 0.000   |
| 36                      | 29-36               | 33.79 | 1.66 | 1650-2734              | 2431.98 | 262.87 | 0.925**               | 0.000   |
| 38                      | 31-36               | 34.32 | 1.39 | 1900-3325              | 2866.54 | 352.98 | 0.944**               | 0.000   |

\*=Significant.

**Table 5:** Correlation of estimated fetal weight and actual birth weight

| Estimated Fetal weight | Actual Birth weight   |         |
|------------------------|-----------------------|---------|
|                        | Pearson's correlation | P-value |
| At 28 weeks            | 0.870**               | 0.000   |
| At 32 weeks            | 0.875**               | 0.000   |
| At 36 weeks            | 0.924**               | 0.000   |
| At 38 weeks            | 0.980**               | 0.000   |

\*=Significant.

**Table 6:** Correlation of placental thickness and actual birth weight

| Placental Thickness | Actual Birth weight   |          |
|---------------------|-----------------------|----------|
|                     | Pearson's correlation | P- value |
| At 28 weeks         | 0.864**               | 0.000    |
| At 32 weeks         | 0.823**               | 0.000    |
| At 36 weeks         | 0.915**               | 0.000    |
| At 38 weeks         | 0.951**               | 0.000    |

\*=Significant

**Table 7:** Mode of delivery

| Mode of Delivery | Frequency  | Percent      |
|------------------|------------|--------------|
| LSCS             | 18         | 18.0         |
| Vaginal          | 82         | 82.0         |
| <b>Total</b>     | <b>100</b> | <b>100.0</b> |

**Table 9:** distribution according to APGAR score.

| APGAR Score  | @ 1 Min    | @ 5 Min    |
|--------------|------------|------------|
| 0 to 3       | 3          | 2          |
| 4 to 6       | 17         | 17         |
| 7 to 10      | 80         | 81         |
| <b>TOTAL</b> | <b>100</b> | <b>100</b> |

Out of 100 fetuses delivered, 80% did not require NICU admission whereas 20% required NICU admission.

**TABLE 10:** NICU ADMISSION

| NICU Admission | Frequency  | Percent      |
|----------------|------------|--------------|
| No             | 80         | 80.0         |
| Yes            | 20         | 20.0         |
| <b>Total</b>   | <b>100</b> | <b>100.0</b> |

## DISCUSSION

Ian Donald introduced use of ultrasonography for localization of placenta in 1965.<sup>15</sup> Until recently, placenta was only evaluated to determine its position and to diagnose premature separation. A more detailed evaluation of placenta has now led to understanding of the morphological changes that take place as the placenta matures. Before the introduction of prenatal investigation techniques, morphological examination of placenta was only useful for retrospective information and had little influence on pregnancy management. Now with the advances in ultrasonography it is possible to examine placenta in detail from the first trimester itself. In current study we have assessed one particular dimension of placenta that is the Placental thickness. In our study the age group of women was between 18 to 35 years with majority

of cases in the age group of 18-25 years (54%). The mean age of women under study was 25.15. 52% were primigravidas while 48% were multigravidas. 82% cases underwent vaginal delivery whereas 18% needed caesarean section. The mean placental thickness in our study at 28 weeks was 27.83, at 32 weeks was 30.58, at 36 weeks was 33.79 and at 38 weeks was 34.32. Our findings are consistent with the study by Sujit Pant, Sunita Dashottar<sup>16</sup> where they reported mean placental thickness at 28 weeks 28.10, at 32 weeks 32.38, at 36 weeks 35.13 and at 38 weeks 36.05.

In a study by Nasreen Noor *et al.*<sup>7</sup> they found that placental thickness at 32 weeks was 30.7, at 36 weeks was 34.1 and at 38 weeks was 33.2 respectively. Ohagwu *et al.*<sup>17</sup> found slightly higher values of placental thickness at corresponding gestational age compared to our study.

**TABLE 8:** COMPARISON OF MEAN PLACENTAL THICKNESS IN DIFFERENT STUDIES.

| Gestational Age | Mean Placental thickness |                          |                            |                      |
|-----------------|--------------------------|--------------------------|----------------------------|----------------------|
|                 | Current study            | Sujit Pant <i>et al.</i> | Nasreen Noor <i>et al.</i> | Ohagwu <i>et al.</i> |
| 28 weeks        | 27.83                    | 28.10                    | -                          | 32.0                 |
| 32 weeks        | 30.58                    | 32.38                    | 30.7                       | 36.0                 |
| 36 weeks        | 33.79                    | 35.13                    | 34.1                       | 39.30                |
| 38 weeks        | 34.32                    | 36.05                    | 33.2                       | 42.49                |



In our study we found that the placental thickness increases with increasing gestational age. Similar findings were reported by Mital P and Hooja N<sup>18</sup> discovering that there is increasing trend in the values of mean placental thickness (in mm) with gestational age. The mean estimated fetal weight calculated by Hadlock formula in our study was 1238.04 at 28 weeks, 1794.23 at 32 weeks, 2431.98 at 36 weeks and 2866.54 at 38 weeks of gestation. In our study we found strong positive correlation between placental thickness and estimated fetal weight at various gestational age with Pearson's correlation coefficient being 0.988 at 28 weeks, 0.898 at 32 weeks, 0.925 at 36 weeks and 0.944 at 38 weeks. The p value was 0.000. Our findings are coinciding with the study by Nour Eldin *et al.*<sup>10</sup> who discovered there is highly significant positive correlation between mean placental thickness and estimated fetal weight with  $r=0.899$ , p value  $<0.001$ . Preeti Baghel *et al.*<sup>19</sup> found that placental thickness by ultrasonography at 32 weeks had significant positive correlation with estimated fetal weight ( $r=0.405$ , p value  $<0.000$ ) and also at 36 weeks ( $r=0.740$ , p value  $<0.000$ ). We found a strong positive correlation between placental thickness at different gestational age with actual birth weight with Pearson's correlation being 0.864, 0.823, 0.915 and 0.951 at 28 weeks, 32 weeks, 36 weeks and 38 weeks respectively. The p value was 0.000. Nour Eldin *et al.*<sup>10</sup> also reported a strong positive correlation between mean placental thickness and actual birth weight ( $r=0.933$ , p value  $<0.001$ ). A study by Aremu Ademola Adegoke *et al.*<sup>20</sup> reported that placental thickness and baby birth weight showed a positive correlation (0.64) and significant P value. Out of 100, 80 neonates did not require NICU admission whereas 20 required NICU admission. Among the 20, 5 were due to preterm delivery, 11 were delivered at term but with low birth weight (also had low mean placental thickness) whereas 4 were delivered at term with normal birth weight but still required NICU admission due to meconium aspiration, secondary apnoea, etc.

## CONCLUSION

Placenta is considered as a 'full of life' organ. Placenta plays a vital role in determining the fate of fetus. Careful evaluation of placenta allows early detection of any deviation in the normal fetal growth. Ultrasound measured placental thickness is an easy and clinically useful parameter of placenta. Placental thickness changes are an expression of normal growth of fetoplacental unit. Assessment of placental thickness can give an idea about certain diseases or abnormalities of fetal growth. Estimation of fetal weight is of utmost importance in antenatal period to not only identify the fetuses with growth retardation but also to make an appropriate plan regarding their delivery and postnatal care.

Ultrasonographic measurement of placental thickness in antenatal period can be an effective, simple, inexpensive, and non-invasive method of estimating fetal growth in peripheral centres where doppler or 3D ultrasound facilities are not available. It can also help for timely referral of the high risk cases and thus help in improving the fetal outcome.

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