Placental Morphometry in Relation to Birth Weight of Full Term Newborn

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Abstract

Background: The placenta is a dynamic organ which is unique in its development and functions. It is the only organ in the body which is derived from two separate individuals, the mother and the foetus. The placenta is responsible for the respiratory, nutritional, excretory, endocrinal and the immunological functions of the foetus. The anomalies of the placenta are usually associated with placental insufficiency, which could lead to complications in the foetus. Hence, a thorough examination of the placenta in-utero, as well as post-partum, gives valuable information about the state of the foetal well being. **Aims:** To study the morphology and the morphometric analysis of the placenta and to clinically correlate it with the foetal parameters, in order to help in the assessment of the state of the well being of the foetus. The placental parameters of 100 placenta and their respective maternal and foetal details were collected, analyzed and clinically correlated. **Result:** The mean placental weight ± standard deviation (SD) was 321.2 ± 63.7 g in SFA group and 388.9 ± 54.1 g in normal weight/ control group. The mean placental surface area ± SD was also lower in SFA group (184.0 ± 61.6 sq.cm) than control group (219.7± 41.6 sq.cm) and the difference was statistically significant. Morphometric parameters of placenta were significantly lower in small for gestational age group babies as compared to full term normal birth weight group babies. **Conclusion:** An adequate knowledge of the morphometry of the placenta and its clinical relevance can prove to be valuable in the early assessment of the foetal well being, especially in a community like ours, where antenatal mothers still come unbooked to the labour room, with no prior investigations done.

Key words: Morphometry of placenta, Mophometric analysis, Placental Anomalies

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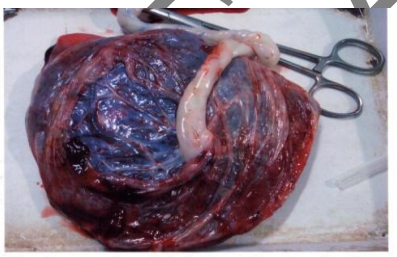
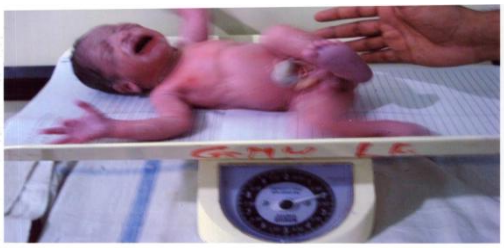
Introduction: A one-minute examination of the placenta performed in the delivery room provides information that may be important to the care of both mother and infant. Healthy placenta is the single most important factor in producing a healthy baby. The placenta, which is in fact part of the fetus, is critical for all aspects of pregnancy from implantation to delivery.

Placenta is the most accurate record of the infant's prenatal experience. It is a unique organ that arises de-novo, and is directly related to growth and development of the fetus. In India about one third of the babies born belong to the low birth weight category. These infants are susceptible to hypoxia, fetal distress, long term handicap and fetal death.[1] Despite observed link between placenta and newborn health, pathological examination of placenta is seldom performed in institutions and thus the etiology for low birth weight in such infants are not well defined.

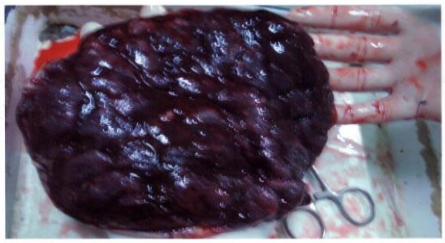
As there is a clear relationship between placental pathology and fetal growth restriction a thorough study of placenta is indispensible to evaluate possible etiological factors. Besides, lack of such studies in the past, especially from our country, strongly motivated us to conduct this study.



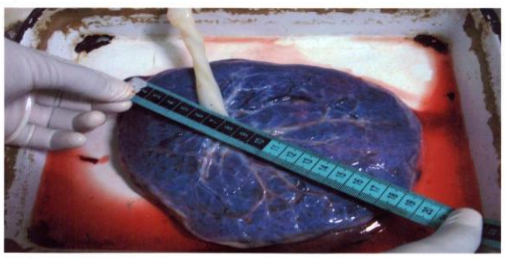
Photograph of fetal surface of placenta showing blood vessels running in chorinic plate deep to the amnion.



Photograph of newborn baby with Baby weighing machine



Photograph of maternal surface of placenta showing cotyledons and grooves around them.



Photograph shows method of measurement of placental diameter with measure tape

WHO has defined *Low birth weight* (LBW) as one whose birth weight is less than 2500 gm irrespective of gestational age. *Very low birth weight* (VLBW) infants weigh less than 1500 gm and *extremely low birth weight* (ELBW) infants weigh 1000gm or less.[1]

A study conducted by Wessel et al estimated that annually 24 million LBW infants are born in developing countries. The incidence of LBW delivery is around 5% in industrialized nations, whereas it varies from 5 to 30 % in under developed or developing nations.[2] The human placenta is the functional center of the maternal fetal system, and is responsible for respiratory, nutritional, excretory, endocrine and immunological functions.[3]

The prevalence of placental pathology in LBW infants was found to be around 80% to 85%. Major pathologies being: Increased placental to fetal weight ratio (64.1%), placental infarction (30%), vascular/ villous abnormalities (20%), acute inflammation and vasculitis (18.5%).[4] Chellam et al examined placenta associated with LBW infants and found chorioamnionitis and funiscitis in 48.5% specimens.[5]

Present Study was conducted a) To study the spectrum of placental changes associated with LBW infants. b) To enumerate possible etiological factors responsible for low birth weight in view of placental abnormalities.

Materials and Methods:

Source of data: Placenta of LBW deliveries will be collected from labor room, Sir T Hospital and Government Medical Collge, Bhavnagar from June 2007 -2008. Detailed history will be taken from patients records. Parturition register & Pediatrician's newborn assessment sheet.

Method of collection of data: Sample size: 100, Sample size was estimated considering the prevalence of placental pathology in LBW infants, with a relative precision of 8% and confidence interval of 95% using N-master software developed by Christian Medical College, Vellore.

Sampling methodology: Non probabilistic purposive sampling wherein all mothers delivering low birth weight babies, i.e. less than 2500 gms was recruited.

Placentas belonging to LBW category shall be obtained from Department of Obstetrics and Gynecology, Sir T Hospital and Government Medical College, Bhavnagar. Collected placentas were drained completely of blood, weighed and washed before formalin fixation. Gross and microscopic examination will be conducted on the collected placentas. Gross lesions would be quantified as "absent" when no visible lesion is noted, "+" if focal lesions are noted and "++" if extensive lesions are noted.

Microscopic studies will be performed on tissue samples taken from each placenta, including atleast 6 blocks of placental tissue, *viz:* 1) a transverse section of umbilical cord; 2) a free membrane section for membrane role; 3) two sections of parenchyma including villi and intervillous space from edge of the placenta; 4) two sections of parenchyma from placental center; 5) one section of each abnormal gross pathology. All of these samples will be stained with haematoxylin and eosin. Microscopic abnormalities will be expressed in percentage.[4]

Statistical Analysis: Descriptive statistics comprising of mean (+ SD) for continuous variables such as age, gestational age along with percentage and proportion for discontinuous data such as placental pathology shall be used. Chi square tests of proportion shall be used to compare the various proportions in different groups. Level of significance shall be fixed at 0.5.

Results: The total placenta collected and examined for the study were 100. There were babies with birth weight less than 2500 g was 25.1 % or 251 per 1000 births. The birth weight was categorized into Low birth weight/ Small For gestational age (SFA) group and normal birth weight/ control group based on birth weight less than 2500 g and 2500 g and above, respectively. The age of the mothers ranged between 18 to 35 years with a mean age of 22.8 years (Standard deviation/ SD of ± 2.4) in study group and 23.6 years (SD± 2.7) in control group. The women in the low birth weight category (<2500 g) were younger than the normal, but the difference was not statistically significant (P>0.05). All the placental parameters like weight, surface

area and volume were compared between these two groups.

The mean placental weight ± standard deviation (SD) was 321.2 ± 63.7 g in SFA group and 388.9 ± 54.1 g in normal weight/ control group. The mean placental surface area ± SD was also lower in SFA group (184.0 ± 61.6 sq.cm) than control group (219.7± 41.6 sq.cm) and the difference was statistically significant. Morphometric parameters of placenta were significantly lower in small for gestational age group babies as compared to full term normal birth weight group babies

The mean placental volume and feto-placental weight ratio were also lower in SFA group than control group

The placenta from SFA group showed significantly higher mean number of cotyledons and infarcted areas than control group. Fresh infarctions were seen more on the surface of 10.6% placenta in SFA group than 5.4% placenta in control group. Calcification was found more in placenta in study group than controls. This showed that infarction and calcification were significantly more in SGA group babies as compared to control groups

Placental parameters that correlated significantly with birth weight were placental weight (r=0.702, $p < 0.01$), surface area (r=0.567, $p < 0.01$) and volume (r=0.870, $p < 0.01$). These findings are shown by scatter diagrams in Graph 3 & Graph 4.

The logistic regression analysis suggested that placental volume and placental weight were the statistically significant variables for the prediction of low birth weight having adjusted for placental surface area and placental thickness.

Discussion:

In obstetrics the relationship of birth weight and the perinatal outcome has long been appreciated, however an often neglected parameter is the morphometry of the placenta, an organ which plays a key role for foetal growth. It receives less attention throughout pregnancy in obstetrics in contrast to the foetal weight.

Morphometric parameters of placenta like weight, surface area and volume were

significantly lower in small for gestational age group as compared to normal group and statistically significant ($p<0.01$). This study shows that placental diameter and thickness measurements are valuable parameters for predicting low birth weight infants. Relations between birth weight and placental area and placental volume have also been described by other studies[6, 7, 8]. A study from India[9] reported that the placental weight was less in both LBW full-term and preterm infants than that of corresponding normal weight infants. This has been attributed to the significant alteration in the morphometry of placenta due to increase in the cytotrophoblastic cellular proliferation and syncytial knot formation in the placental villi that result in the disturbance of hormonal factors. Hence an altered morphometry of placenta results into IUGR and low birth weight of the baby.

Many factors such as race, socioeconomic problems, health problems, etc are associated with placental weight[9]. Studies have shown that diminished placental size precedes foetal growth retardation[10]. In another study of small for gestational age group babies, placentae findings were less in small for gestational age group babies than that of normal group[11, 12]. Clappe *et al*[13] and Kinare *et al*[14] reported an association between second trimester placental volume and birth weight. Bjoro[15] and Laurini[16] found out that infarction was more in small for gestational age group babies as compared to normal group. The present study showed that placental weight increased according to birth weight, which concurs with other studies[17, 18]. Placental weight was strongly correlated with newborn birth weight. Hence placental parameters serve as a good and easily comparable measurement for placental size and as a proxy measurement for the quality and efficiency of the placenta and thereby birth weight of newborn babies.

This study confirms an earlier observation by Lurie *et al*. that low fetal-placental weight ratio was associated with low foetal weight[19]. Heinonen *et al.*[20] in 2001 demonstrated that SGA infants show lower feto-placental weight ratios than normal weight infants. From this study it is clear that measurement of early placental parameters improves the ability to predict birth size. This may be helpful in earlier

identification of at risk foetus and thus facilitate preparation for management at least in neonatal and childhood period. The gross placenta should be more fully assessed, as birth weights discordant with placental size and shape measures appear to have lasting impact.

Conclusion: The morphometry of placenta like weight, surface area and volume show significantly lower values in the SGA group than the normal birthweight group. Placental parameters are directly proportional to the birth weight of babies. The early measurements of placenta by non-invasive technique like ultrasonography will be helpful in early identification of at risk fetus and better management of such pregnancies. In conclusion, the measurement of placental parameters in all sonographic assessment of pregnancy may become a valuable additional tool to help increase our ability in predicting low birth weight infants. Because of this the placenta should be moved into the focus of research interest in future also.

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