

Original research article

Morphometric analysis of the association between placenta and birth weight of full term newborns in Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

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Abstract

Background: Placenta is a vital organ for maintaining pregnancy and promoting normal fetal development and function. It is the only organ in the body which is derived from two separate individuals, the mother and the fetus. It is responsible for their respiratory, nutritional, excretory, endocrine and the immunological functions of the fetus. Birth weight is an important determinant of child survival, healthy growth and Development.

Aim: to determine the morphometric of placenta in relation to birth weight of full term newborns in Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

Materials and methods: The present study was conducted in Department of Anatomy. Total 120 discarded placenta were collected at random from deliveries (both vaginal and caesarian) conducted Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, for 15 months. 60 out of the 120 placenta were from controls (birth weight > 2500gms) and 60 from low birth weight deliveries (birth weight <2500gms). In the collected placenta, the weight, volume, diameter and thickness of placenta were measured. **Results:** Out of 120 placentas which were equally distributed between two groups, group A which included placenta of normal birth weight newborns and group B which included placenta of low birth weight newborns. The 68.33% of placenta had birth weight 400-500 gms and followed by 31.67% >500 gms in group A, and 63.33% of placenta had birth weight <400 gms in group B. 41.67% of placenta had volume 401-499 ml and followed by 31.67% of placenta had volume ≤ 400 ml in group A and 78.33% of placenta had ≤ 400 ml volume in group B. The mean placental weight was 458.97±32.04gms in normal birth weight group and 373.88±47.23 gms in the low birth weight group. The mean placental diameter was 19.88±0.93cm in normal birth weight group and 16.96±2.32cm in the low birth weight group. The mean placental thickness was 1.85±0.32cm in normal birth weight group and 1.73±0.22cm in the low birth weight group. The mean placental volume in the normal birth weight group was 442.09± 41.12ml and in the low birth weight group it was 373.88±47.23 ml.

Conclusion: we concluded that the values of placental weight, volume were lower in small for gestational age group babies as compared to full term normal group babies. The volume of the placenta is directly proportional to the birth weight of the baby.

Key words: Birth weight, Placenta, Placental morphometry

Introduction

The antenatal health care given to pregnant women has great influence on the rates of perinatal death and morbidity. Amongst the different causes of perinatal mortality, low birth weight (LBW) is the single most significant factor and about 2/3 deaths among infants with less than 2500 g birth weight. Low birthweight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams. This is based on epidemiological observations that infants weighing less than 2,500 g are approximately 20 times more likely to die than heavier babies. More common in developing than developed countries, a birthweight below 2,500 g contributes to a range of poor health outcomes.¹ The low birth weight rate for industrialized countries was around 7 per cent, and in less developed countries it ranged between 5 and 33 per cent, with an average of 17 per cent. Around the year 2000, UNICEF and WHO accelerated efforts to estimate global and country rates. The process of monitoring progress towards international goals on low birth weight reduction led to a greater recognition of the limitations of the available data, in particular the relatively small proportion of infants weighed at birth.^{2,3} Epidemiological data indicate that placental weight, albeit a crude proxy for placental structure, appears to provide information on the long-term outcome for the baby. The changes in placental growth represent an important link between perturbations in the maternal compartment (such as reduced placental blood flow, altered maternal nutrition and diabetes) and alterations in fetal growth. A lack of a normal increase in maternal placental blood flow, leading to 'placental insufficiency'. The placenta constitutes the active interface between the maternal and fetal blood circulations, regulating maternal physiological changes in pregnancy and fetal growth and is thought to play an important role in the development of many pregnancy complications. A link between intrauterine environment and adult disease was pioneered by Barker and co-workers, who reported associations between low birth weight and the risk of developing Type 2 diabetes^{4,5} and cardiovascular disease⁶ A baby's low weight at birth is either the result of preterm birth (before 37 weeks of gestation) or due to restricted fetal (intrauterine) growth. Low birth weight is closely associated with fetal and neonatal mortality and morbidity, inhibited growth and cognitive development, and chronic diseases later in life. Many factors affect the duration of gestation and foetal growth, and thus, the birth weight. They relate to the infant, the mother, or the physical environment and play an important role in determining the birth weight and the future health of the infant. The present study was aimed to determine the morphometric of placenta in relation to birth weight of full term newborns in anugrah narayan magadh medical college and hospital, gaya, Bihar, India.

Materials and methods

The present study was the conducted in Department of Anatomy. Total 100 discarded placentae were collected at random from deliveries (both vaginal and caesarian) conducted Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, for 15 months, after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

The cases were studied dividing into two experimental groups. 60 out of the 120 placentae were from controls (birth weight > 2500gms) and 60 from low birth weight deliveries (birth weight <2500gms). In the collected placenta, the weight, volume, diameter and thickness of placenta were measured. The feto-placental ratio was calculated by dividing the weight of the foetus by weight of the placenta and the placental coefficient was calculated by dividing placental weight by birth weight. The placenta with attached membranes and umbilical cord was collected soon

after delivery washed in running tap water to clean all blood. Each specimen was tagged with number before commencement of the study, for the purpose of identity.

Results

The present study was done with 120 placenta which was equally distributed between two groups, group A which included placenta of normal birth weight newborns and group B which included placenta of low birth weight newborns. Table 2 show that the 68.33% of placenta had birth weight 400-500 gms and followed by 31.67% >500 gms in group A, and 63.33 % of placenta had birth weight <400 gms in group B. 41.67% of placenta had volume 401-499 ml and followed by 31.67% of placenta had volume \leq 400 ml in group A and 78.33% of placenta had \leq 400 ml volume in group B. Table 3 show that the mean placental weight was 458.97 ± 32.04 gms in normal birth weight group and 373.88 ± 47.23 gms in the low birth weight group. The mean placental diameter was 19.88 ± 0.93 cm in normal birth weight group and 16.96 ± 2.32 cm in the low birth weight group. The mean placental thickness was 1.85 ± 0.32 cm in normal birth weight group and 1.73 ± 0.22 cm in the low birth weight group. The mean placental volume in the normal birth weight group was 442.09 ± 41.12 ml and in the low birth weight group it was 373.88 ± 47.23 ml. The mean foeto-placental ratio in normal birth weight group was 6.44 whereas in low birth weight group, it was 5.66. All the parameter was found to be statistically significant. In the present study the placental coefficient in normal birth weight group was 0.166 ± 0.013 and in low birth weight group was 0.197 ± 0.026 .

Table 1: Number of cases

Groups	N=120
Group A (Placentae of normal birth weight)	60
Group B (Placentae of low birth weight < 2500g)	60

Table 2: Relation of birth weight with placental weight and volume

Parameters		Group A (Placentae of normal birth weight)=60		Group B (Placentae of low birth weight < 2500g)=60		Total=120	
		No.	(%)	No.	(%)	No.	(%)
Weight of placenta (gms)	<400	0	0	38	63.33	38	31.67
	400-500	41	68.33	22	36.67	63	52.50
	>500	19	31.67	0	0	19	15.83
Volume of placenta(ml)	\leq 400	19	31.67	47	78.33	66	55
	401-499	25	41.67	9	15	34	28.33
	\geq 500	16	26.67	4	6.67	20	16.67

Table 3: Comparison of mean of various variables

Variable	Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		p Value
	Mean	SD	Mean	SD	
Birth weight	2866.63	221.03	2021.87	355.87	<0.001**
Placental weight	458.97	32.04	387.63	61.36	<0.001**
Placental volume	442.09	41.12	373.88	47.23	<0.001**
Placental diameter	19.88	0.93	16.96	2.32	<0.001**
Placental thickness	1.85	0.32	1.73	0.22	<0.001**
Placental coefficient	0.166	0.013	0.197	0.026	<0.001**

Feto-placental ratio	6.44	0.32	5.66	0.77	<0.001**
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Discussion

Intra uterine growth retardation is a complication of many pregnancies. The factors responsible for fetal growth retardation include maternal malnutrition, anemia, preeclampsia, eclampsia, maternal infection, drug abuse, genetic factors, genetic diseases, congenital malformations multiple gestations, placental/cord abnormalities and maternal smoking. The miscellaneous causes like short interpregnancy intervals, race, maternal age and low socioeconomic status also contribute in small for gestational age in babies. In many cases specific cause is never identified. Growth and survival of the fetus is essentially dependent on development, formation, maturation and function of the placenta. The etiology of low birth weight is multifactorial; with genetic, placental, fetal and maternal factors interplaying with each other. Despite the observed link between maternal health, placenta and newborn health, any kind of placental study is not routinely performed in hospitals. However a study focused at least on the placenta of low birth weight babies will shed light on the causative factors and will help in the better understanding of the etiology. Hence the present study is undertaken to analyze the spectrum of morphometric changes in placenta and its relation with birth weight of full term newborns.

In the present study the mean placental weight was 458.97 ± 32.04 gms in normal birth weight group and 373.88 ± 47.23 gms in the low birth weight group and was found to be statistically significant. Placental weight and thickness has been taken as an indicator of placental function. Surya Babu et al studied 50 placentae of low birth weight babies and found that the placental parameters like weight and size of the placenta were significantly less than normal in low birth weight deliveries.⁷ In a larger population size from Mexico (n: 300 live newborns) Sanin established a model to relate birth weight with placental weight.⁸ Placental weight was found to be significantly related to birth weight. For each gram increase of weight of placenta, the birth weight increased by 1.95 gms ($p < 0.01$). The placenta however was shown to have a nonlinear relation to birth weight and could be used as a useful noninvasive predictor of birth weight. The mean placental diameter was 19.88 ± 0.93 cm in normal birth weight group and 16.96 ± 2.32 cm in the low birth weight group. It was found to be statistically significant. According to a study by Habib FA a “warning limit” of a placental diameter of 18 cm and placental thickness of 2 cm at 36 weeks gestation were calculated to predict low birth weight infants.⁹ The mean placental thickness was 1.85 ± 0.32 cm in normal birth weight group and 1.73 ± 0.22 cm in the low birth weight group. It was found to be statistically significant. The mean thickness of term placenta reported by Gunapriya et al., was 2.1cm, in other study by Hatti AM it was 2.21cm whereas, in the study of Rupa L Balihallimath et al. the mean placental thickness was 2.1 cm, 5th and 95th percentiles of placental thickness varied from 1.5 to 3.0 cm, with no significant relationship with birth weight.¹⁰⁻¹² In the present study, The mean placental volume in the normal birth weight group was 442.09 ± 41.12 ml and in the low birth weight group it was 373.88 ± 47.23 ml which was statistically significant.

In the study by Rupa L Balihallimath et al., the mean placental volume was 366.08 ± 1.10 ml, with a significant positive correlation between the weight of the baby and the placental volume ($r = 0.662$ ml; $p < 0.001$).¹² This result is consistent with the other studies.^{13,14} In a study by R.D. Virupaxi et al. morphometric parameters of placenta like weight and volume were significantly lower in small for gestational age group babies as compared to full term normal group babies, these values were statistically significant ($p < 0.0001$).¹⁵ Foeto-placental ratio is the ratio of fetal weight to placental weight. The normal ratio is 1:7. The mean foeto-placental ratio in normal birth weight group was 6.44 whereas in low birth weight group, it was 5.66. The difference between two groups was statistically significant ($p < 0.001$).

Placental coefficient is defined as the ratio of placental weight to fetal weight. Normally it is 0.10 to 0.18.¹⁶ This correlated well with the present study. In the present study the placental

coefficient in normal birth weight group was 0.166 ± 0.013 and in low birth weight group was 0.197 ± 0.026 . The placental coefficient falls as the placental weight increases and high placental coefficient is seen if the placental weight decreases. Placental coefficient outside the normal range is shown to be associated with perinatal adverse effects.¹⁶

Conclusion

We concluded that the values of placental weight, volume were lower in small for gestational age group babies as compared to full term normal group babies. The volume of the placenta is directly proportional to the birth weight of the baby. Measurement of the placental volume can be done by the noninvasive technique like ultrasonography (USG) and this will be helpful in assessing the development of the baby.

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