Research Article

Study of placental weight in normal and pre-eclamptic pregnancies and its correlation with birth weight

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Abstract

Background: Placenta reflects the well being of the fetus and continuously undergoes a change in weight and function, to support the development of the fetus. The aim of this study was to assess and correlate the weight of placenta and fetal birth weight in normotensive and hypertensive pregnancies. **Materials and Methods:** Fifty placenta each of normotensive and pre-eclamptic pregnancies were studied (n=100). After delivery, weight of placenta and fetal weight was recorded using weighing machine. **Results:** In this study, 68.19% cases of low birth weight babies were found in pre-eclamptic group. Mean placental weight was 454.24 ± 47.52 grams and mean fetal weight was 2633.6 ± 302.2 grams in normal group. Whereas, in pre-eclamptic group, mean placental weight was 406.32 ± 59.33 grams and mean fetal weight was 2435.2 ± 280.56 grams. Mean placental and fetal weight were significantly lower in pre-eclamptic group, whereas, feto-placental weight ratio was significantly higher in pre-eclamptic group. A significant positive correlation was found between placental and fetal birth weight ($r = 0.975$, $p<0.0001$) in normal and ($r = 0.971$, $p<0.0001$) in pre-eclamptic group. **Conclusion:** Pre-eclamptic pregnancies significantly reduce placental weight. These changes may be due to placental insufficiencies as a result of compromised uteroplacental blood flow in pre-eclamptic pregnancies. The present study shows a strong positive correlation between placental and fetal weight. So, the knowledge of this correlation will be tremendously useful in the early assessment of placental insufficiencies and also the state of fetal well being.

Key words: Fetal weight, Placenta, Pre-eclampsia.

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Introduction

The placenta is a complex multifunctional organ of mainly fetal origin with pleiotropic roles during fetal growth. It has a fetal portion derived from the developing embryo and a maternal portion formed by the modification of the uterine lining of the mother [1]. A healthy placenta is the most important factor in producing a healthy baby. During the gestational period, it provides nutrition, gas exchange, waste removal, endocrine, immune support and a special circulation system to the developing fetus [2, 3]. The growth of human fetus is limited by the inability of the mother and placenta to adequately supply nutrients and oxygen to the fetus and the consequence of fetal undernutrition is reduced growth and low birth weight [4]. The placental nutrient transfer is also affected by the electrochemical gradient, blood flow and morphological characteristics e.g. the surface area and thickness of placenta [5]. Placenta is focus of increasing interest in modern obstetrics because significant pathology affects the placenta, often before affecting the fetus. Therefore, such placental changes can be an "early warning system" for fetal problems [6]. Pregnancy associated complications like hypertension or gestational diabetes are reflected in the placenta in a significant way both macroscopically and microscopically. Preeclampsia is associated with increased vascular resistance and decrease in uteroplacental perfusion. According to the

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degree of decrease in uteroplacental perfusion fetal hypoxia and Intra uterine growth restriction can become unavoidable [7]. The present study has been undertaken to evaluate the effects of hypertension on placental and fetal birth weight and to correlate their relationship.

Materials and Methods

The study was carried out in the Department of Anatomy and Department of Obstetrics and Gynaecology, Gandhi Medical College, Bhopal (M.P). One hundred placentae taken from pregnant women delivered in Sultania Zanana Hospital associated to G.M.C. Bhopal, after permission from institutional ethics committee and informed consent of all participants. Women were diagnosed with preeclampsia if they had systolic BP ≥140mmHg, diastolic BP ≥90mmHg measured on two or more occasions at least 4 hrs apart after 20th week of gestation with proteinuria [8]. Proteinuria was considered present when there was a urine dipstick value of at least 1+ (>30mg/dl) on two separate occasions at least 6 hours apart. On this basis, subjects were divided into two groups. Group I consist of placentae obtained from normal pregnant women (n=50) with gestational age 37-40 weeks. Group II consist of placentae obtained from pre-eclamptic women (n=50) of similar gestational age. Patients with essential hypertension, diabetes mellitus, anaemia, renal disorders and other illness associated with pregnancy were excluded from this study. The mothers and their neonates identified for this study were given code numbers and studied at the hospital. After delivery, fetal birth weight and placental weight was recorded using standard weighing machine. Placental coefficient was calculated by the following formula:

Placental coefficient = placental weight in grams / birth weight in grams

Statistical analysis of data was performed by using Statistical Package for Social Sciences (SPSS) version 15.0 (Chicago, IL). The values of continuous variables were presented as mean values ± standard deviation. The statistical significance between control and study group was analyzed by using student t-test for continuous variables and Chi-square test for categorical data. Correlation between fetal and placental weight was analyzed by using Pearson's correlation coefficient. The significance of differences between group parameters were considered significant if $p < 0.05$.

Results

In our study, fetal birth weight of less than 2500 grams were found in 30 (68.19%) cases of pre-eclamptic group and 14 (31.81 %) cases of normal group. Thus cases of fetal low birth weight (<2500 grams) was more in the pre-eclamptic group as compared to normal group. The differences of fetal birth weight between two groups were statistically significant [Table 1]. Mean fetal birth weight was 2435.2 ± 280.56 grams in pre-eclamptic group and 2633.6 ± 302.2 grams in normal group, which indicates that fetal birth weight was significantly lower in pre-eclamptic group as compared to the normal group [Table 3].

Table 1: Distribution of weight of the fetus in normal and pre-eclamptic pregnancies

S. No.	Weight of fetus (in grams)	Normal group (n=50)	Pre-eclamptic group (n=50)	Total (n=100)
1.	Less than 2500 grams	14 (31.81%)	30 (68.19%)	44 (100%)
2.	More than 2500 grams	36 (64.28%)	20 (35.72%)	56 (100%)

Chi-square (χ^2) = 10.38, df =1, p<0.01, highly significant.

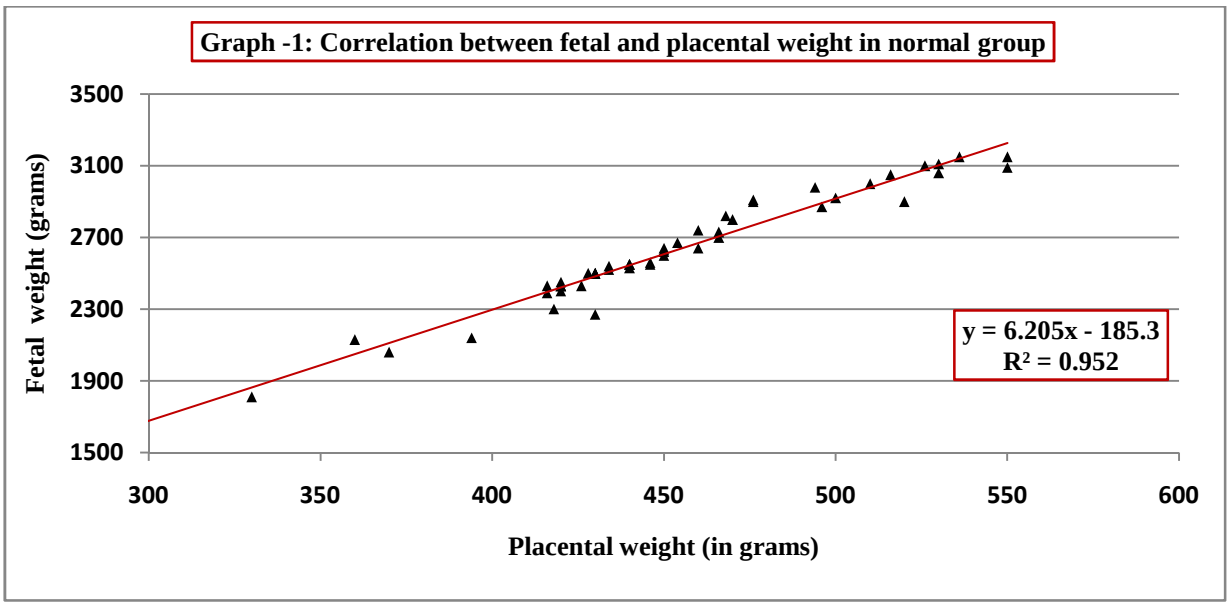
Table 2: Distribution of weight of the placenta in normal and pre-eclamptic pregnancies

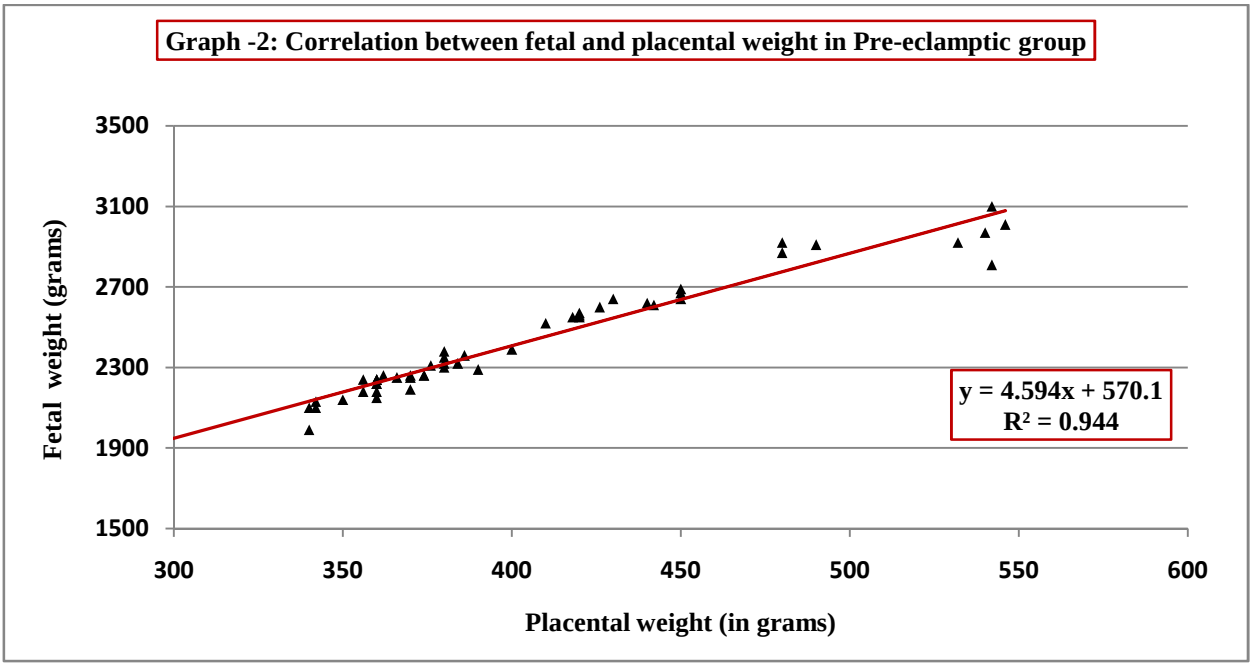
S. No.	Weight of placenta (in grams)	Normal group (n=50)		Pre-eclamptic group (n=50)	
		No.	%	No.	%
1.	<350	1	2	5	10
2.	351-400	3	6	25	50
3.	401-450	25	50	12	24
4.	451-500	12	24	3	6
5.	>500	9	18	5	10

Table 3: Comparison of fetal weight and placental weight in normal and pre-eclamptic pregnancies

S. No.	Parameters	Normal group (n=50)	Pre-eclamptic group (n=50)	P value
1.	Mean fetal weight	2633.6 ± 302.20	2435.2±280.56	<0.05*
2.	Mean placental weight	454.24 ±47.52	406.32±59.33	<0.05*
3.	Mean feto-placental weight ratio	5.79±0.15	6.01±0.22	<0.05*
4.	Placental coefficient	0.17±0.004	0.16±0.006	<0.05*

Student t-test <0.05 – significant.





In present study, the placental weight ranges between 330-550 grams. Placental weight in 50% cases of the pre-eclamptic and normotensive group was ranged between 351-400 grams and 401-450 grams respectively [Table-2]. The mean placental weight was 406.32 ± 59.33 grams in pre-eclamptic group, whereas 454.24 ± 47.52 grams in normal group. Thus placental weight is significantly lower in pre-eclamptic group as compared to the normal group, whereas, mean feto-placental weight ratio was significantly higher in pre-eclamptic group as compared to normal group. Average placental coefficient is 0.16 in pre-eclamptic group and 0.17 in normal group. Thus placental coefficient is significantly lower in pre-eclamptic group [Table-3].

In the normal group, there was a significant positive correlation (Pearson correlation coefficient r= 0.975, p< 0.0001) between fetal birth weight and placental weight. From the Graph-1, it is clear that higher value of placental weight is associated with higher value of fetal birth weight. The linear relationship is expressed by the following equation:

$$y = 6.205 (x) – 185.3$$

Where x is the weight of the placenta in grams and y is the fetal birth weight in grams. The estimator of its slope is given by +6.205 gm/gm and the estimator of its intercept is given by – 185.3 gm. The interpretation of the slope of the regression line is that on average, an increase placental weight of 100 gm in control group is accompanied by an increase fetal birth weight of 620.5 gm.

In the pre-eclamptic group, a significant positive correlation (Pearson correlation coefficient r= 0.971, p< 0.0001) was found between fetal birth weight and placental weight. For the pre-eclamptic group [Graph-2], the relationship between fetal birth weight and placental weight is given by the following equation:

$$y = 4.594 (x) + 570.1$$

Where x is the weight of the placenta in grams and y is the fetal birth weight in grams. The estimator of its slope is given by +4.594 gm/gm and the estimator of its intercept is given by +570.1 gm. The interpretation of the slope of the regression line is that on average, an increase placental weight of 100 gm in pre-eclamptic group is accompanied by an increase fetal birth weight of 459.4 gm. A test of linearity of the relationship between fetal birth weight and placental weight is significant.

Discussion

Fetal birth weight can be influenced by both endogenous and exogenous factors. These factors include gestational age at delivery, physiological factors (altered glucose metabolism, hemoglobin concentration, macro vascular integrity), pathological factors (hypertension, uterine malformation), and complications of pregnancy (gestational diabetes mellitus, preeclampsia) [9]. Fetal birth weight decreases with increasing grades of hypertension [10]. Datta K.D. et al, observed that babies weighing less than 2.5 Kg were seen in 22.73% cases of eclampsia, 13.3% in mild eclampsia and 6.25% in control groups [11]. Londhe P.S. et al, observed that babies born with low birth weight (less than 2500 grams) were more in hypertensive groups (69.3%) as compared to control groups [12]. This finding is similar to our finding. We observed 68.19% cases of low birth weight fetus in pre-eclamptic group [Table-1].

The present study reveals that the mean fetal birth weight is significantly lower ($p<0.05$) in the pre-eclamptic group as compared to normal group [Table-3]. This finding corroborates with the studies of Udania A. et al [13], Majumdar S. et al [14], Singh S. et al [15] and Salmani D. et al [16].

The placenta has complex metabolic and endocrine activities and is important for growth and survival of the fetus in utero. The growth of the placenta is directly proportional to its functional efficiency as it is the only fetal source of nutrients and oxygen [17]. The weight of the placenta gives an idea about the amount of substance that is exchanged between the mother and the fetus. Placenta being a fetal organ shares the same stress and strain, to which the fetus is exposed. Thus any disease process affecting the mother and fetus also has a great impact on placenta [13].

Hosemann reported placental weight of 400-1000 grams in normal term pregnancy [18] where as Wigglesworth reported 360-570 grams of placental weight in normal term pregnancy [19]. The present study shows placental weight ranged between 330-550 grams [Table-2] which is lower than the findings of Hosemann [18] but similar to the findings of Wigglesworth [19].

Table 4: Comparison of fetal weight and placental weight with previous study.

Author's	Mean fetal weight (in grams)		Mean placental weight (in grams)		Feto-placental weight ratio	
	Normal group	Hypertensive group	Normal group	Hypertensive group	Normal group	Hypertensive group
Udania A. et al, (2001) [13]	2640.0	2280.0	495.0	405.67	-	-
Majumdar S. et al, (2005) [14]	2800.0	2040.0	485.85	399.0	5.89:1	6.23:1
Singh S. et al, (2014) [15]	3140.9	2329.72	435.92	345.96	7.2:1	6.7:1
Salmani D. et al, (2014) [16]	3140.0	2440.0	519.8	395.15	5.72:1	6.35:1
Londhe PS. et al, (2015) [12]	2730.0	2260.0	401.8	312.93	6.79:1	7.23:1
Gautam G. et al, (2015) [10]	2634.59	2349.0	486.78	423.4	5.78:1	5.21:1
Present study	2633.6	2435.2	454.24	406.32	5.79:1	6.01:1

Das B. et al observed that placental weight was significantly reduced where the duration of hypertensive disorders were prolonged. A significant increase in the incidence of intrauterine growth retardation and still birth was found with the lower placental weight [20]. In the present study, mean placental weight is significantly lower (<0.05) in pre-eclamptic group as compared to normal group [Table-3]. This is in concurrence with the finding of Londhe P.S. et al. [12], Majumdar S. et al. [14], Singh S. et al. [15] and Gautam G. et al [10].

The feto-placental unit was adversely affected in pregnancy induced hypertension. Due to placental insufficiency the fetal growth was affected. Correlation of the fetal weight and placental weight is assessed by feto-placental weight ratio. The ratio of the fetal weight to the placental weight is known as the feto-placental weight ratio, which is normally 6:1 [21]. In the present study, the average feto-placental weight ratio in normal pregnancy is 5.79, whereas in pre-eclamptic pregnancy it is 6.01 [Table-3]. These values correlate with the study done earlier by Salmani D. et al [16]. In the present study, the mean feto-placental weight ratio is significantly higher ($p<0.05$) in pre-eclamptic group as compared to normal group [Table-3]. This finding corroborates with the studies of Majumdar S. et al. [14], Londhe P.S. et al [12] and Salmani D. et al [16]. In contrast to our finding, Gautam G. et al, [10] and Singh S. et al, [15] showed a progressive decrease in feto-placental weight ratio with increasing grades of hypertension.

Another method to correlate the weight of the baby and placenta is by assessing the placental coefficient. The normal placental coefficient is 0.12-0.20. In our study, average placental coefficient is 0.16 in pre-eclamptic group and 0.17 in control group, which coincides with the normal value [Table-3]. These values correlate with the study done earlier by Singh S. et al. [15] and Raghunath G. et al [22].

Hamilton W.J. et al. [23], Vasudeva N. et al. [24], and Garg K. et al. [25] have shown that there is a linear correlation between placental weight and fetal weight. Udainia A. et al [13] and Londhe P.S. et al [12] also found a significant correlation between placental weight and fetal weight in pregnancy induced hypertensive group and normal group. This is also correlated by the present study. The weight of the placenta is found to have a significant positive correlation with fetal birth weight in both groups [Graph-1 & 2], it implies that, factors which directly affect the placental weight will indirectly affect the fetal birth weight. Such factors include nutrition, maternal haemoglobin, gestational age, complicated

metabolic diseases (maternal diabetes mellitus, hypertension) etc. Therefore, proper examination of the placenta in-utero, as well as post partum, gives valuable information about the state of the fetal well being.

Conclusion

Placental weight was significantly reduced in pre-eclamptic pregnancies and it was directly correlated with fetal birth weight. So, hypertensive disorders of pregnancy adversely influence the placental weight, which ultimately, adversely influence the maternal and perinatal outcomes. We can estimate the fetal birth weight from the weight of placenta by using correlation equations. An adequate knowledge of this correlation will be useful in the early assessment of placental sufficiency and state of fetal well being.

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