Original Article

Gross Morphological Variation in Preterm Placenta in Gestational Diabetes Mellitus and Pregnancy Induced Hypertension

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Abstract

Background: *Preterm birth is the primary cause of perinatal mortality and morbidity. Recently, it has become a significant issue in public health policies of developing countries. Among the various causes, pregnancy induced hypertension (PIH) and Gestational diabetes mellitus (GDM) are two important high-risk factors for preterm birth. Again, placenta is a mirror that reflects the well-being of the fetus and continuously undergoes a change in weight, structure, shape and function in order to support the well-being of the fetus.* ***Objective:*** *To make an in-depth analysis on the possible gross morphological changes in preterm placenta in respect of GDM and PIH.* ***Materials and Methods:*** *The study was observational, analytical and cross sectional. The patients under this study were selected from the Obstetric ward of BSMMU and BIRDEM Hospital, from June 2005 to October 2005. A total of sixty-six samples were collected from women during 28 weeks to 36 completed weeks of gestation. Among them, twenty-two samples were from mothers having GDM, twenty-two having PIH and twenty-two belonged to normal pregnancy (control group). The placentas were examined to measure their diameter, thickness, cotyledons number, weight, and volume.* ***Results:*** *In this study, the GDM group showed significantly higher values for the variables of diameter, weight, volume and number of cotyledons as compared to PIH group. On the other hand, the thickness of the placenta showed lower values in GDM group, but the result did not reach a significant level.* ***Conclusion:*** *From the findings of this study, it is difficult to establish a clear-cut correlation about placental changes in diabetic and hypertensive mothers during pregnancy. However, the changes in placental weight, volume and diameter found in gestational diabetic mother may be a long term compensatory mechanism, aiming to secure a sufficient nutrient supply to support the growth of the foetus. So, postnatal examination of the placenta can yield information that may be important for immediate and late management of the mother and neonate.*

Key words: *Preterm Placenta, GDM, PIH, Gross morphology.*

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Introduction

Perinatal mortality depicts the health care progress of a country. Globally, perinatal mortality rate (PMR) is 49.6 per 1000 live birth[1] and one of the major causes of perinatal mortality is preterm birth that accounts for 6-10% of all births.[2] The onset of preterm birth initiates when the intrauterine environment becomes hostile. Among the various high risk factors gestational diabetes mellitus (GDM) and pregnancy induced hypertension (PIH) are two important disorders when both mother and the foetus are in a

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vulnerable state. The placenta, as a fundamental organ within these complexities of intrauterine life, may represent an adaptive response and tries to compensate to prevent any foetal complications. It undergoes a change in weight, volume, structure, shape and functions continuously throughout gestation in order to support prenatal life[3] and aimed at preparing the foetus for extrauterine life.[4] However, in GDM and PIH mother, a wide variety of gross morphological changes have been reported. In GDM mother, an increase in placental weight, large size of the placenta has been documented.[5-7] On the other hand, in PIH it was observed that placental weight become significantly decreased in several studies.[8,9]

Considering this compensatory patho-physiological effect of placenta in these two disorders, the present study was set to find out any gross morphological variations in preterm placentas in between GDM and PIH mothers and also to compare these variations with placentas of nondiabetic and nonhypertensive mothers.

Materials and Methods

Sixty-six placentas were selected from Bangladeshi women who gave birth to a single alive baby through caesarean section after 28 to 36 completed weeks of gestation. Specimens were collected from Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Dhaka, and Bangabandhu Sheikh Mujib Medical University (BSMMU) Dhaka from June 2005 to October 2005. All the placentas were collected as soon as possible after delivery from the obstetric operation theatre. The study was done in the department of Anatomy, BSMMU, Dhaka during the study period of January 2005 to December 2005.

Among sixty-six placentas, twenty-two were collected from GDM mothers, twenty-two from PIH mothers and the remaining twenty-two from nondiabetic and normotensive mothers were considered as control group. Mothers with long standing diabetes mellitus or hypertension, or preeclampsia, Rh-negative blood group, positive ANA (anti-nuclear antigen), positive VDRL, multiple gestations in current pregnancy, severely anemic (Hb% <7gm/dL) as well as mothers delivering congenitally malformed babies were excluded from the study.

The placentas were collected in labeled plastic bags. Immediately after collection, the following gross morphological variables of each placenta for three groups were studied.

1. **Diameter of the placenta** – The placentas were kept on a flat tray and membranes were trimmed from their edges. Blood was removed gently from both surfaces with cotton wool and the umbilical cord was cut about 2 cm proximal to its insertion.[10] Then the maximum diameter of each placenta was measured with a metallic scale graduated in centimeters. At right angles to the first one, the second maximum diameter was recorded (Fig 1). Then the mean of these two measurements was considered as the diameter of each placenta.[11]

2. **Thickness of the placenta** – Placental thickness measured by piercing a large needle through five points. To do this, each placenta was arbitrarily divided into three equal zones –central, middle and peripheral by drawing two imaginary circles on its maternal surface, keeping the center of placenta as an axis[11] (Fig 2).

3. **Number of cotyledons** – Placenta was taken on both hands facing the fetal surface upward. Then gentle pressure was applied from the central part of the foetal surface to periphery with the thumbs of both hands while the peripheral part was held by the other fingers. This maneuver caused separation of the cotyledons to make them prominent in the maternal surface. Then it was put on a tray with maternal surface facing upwards by placing a wooden-block on the fetal surface. Counting was started from left side of one end and going through rightward. In this way, counting was continued in spiral manner[11] (Fig 3).

4. **Weight of the placenta** – After recording the above variables, weight of each placenta was recorded in grams using a weighing machine.

5. **Volume of the placenta** – The volume of the placenta was measured by immersing it in water in a plastic bucket to which a plastic drawing-

tube was attached. The displaced water drained through the tube was collected in a container and measured in a graduated cylinder in milliliters.[12]

Results were obtained by calculating means, standard deviations (SD) and analyzing significant difference using a computer-based program (SPSS, version11). The post Hoc option of analysis of variance (ANOVA) was done to compare three groups for each variable. The difference was considered to be significant statistically at 5% level (i.e. $P<0.05$).

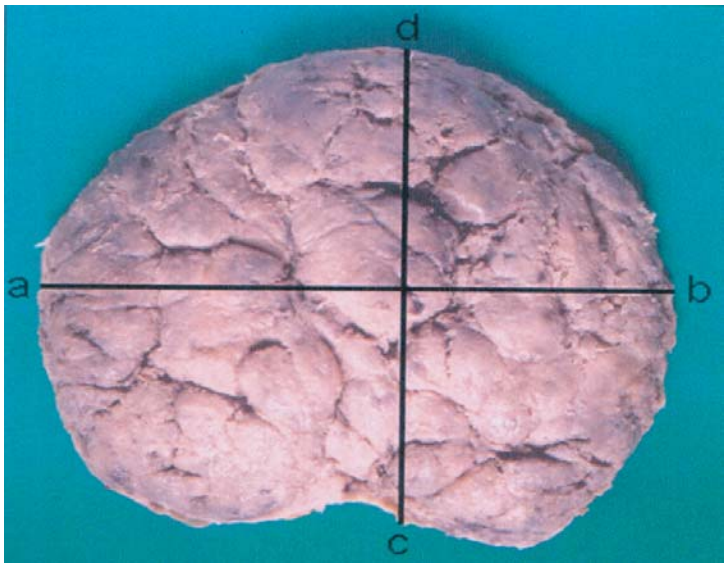

Fig 1. Photograph of the maternal surface of a placenta showing the procedure of measurement of its diameters. Line ab shows the apparently maximum diameter, while line cd shows the apparently maximum diameter at right angles to line ab.

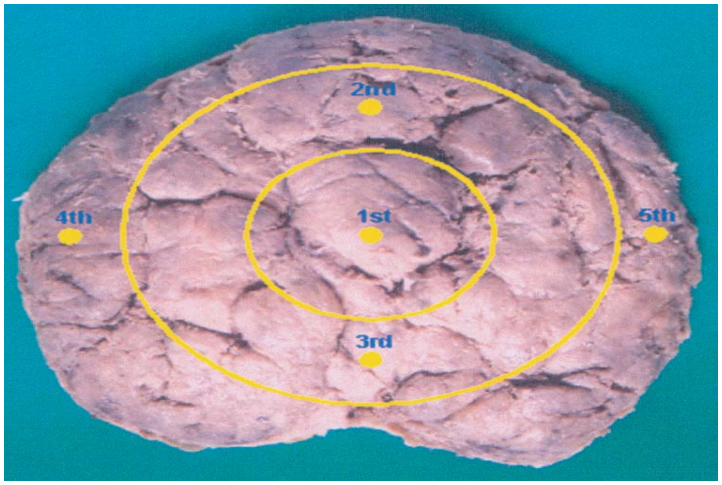

Fig 2. Photograph of the maternal surface of a placenta with division into three zones showing five points for the measurement of its thickness.

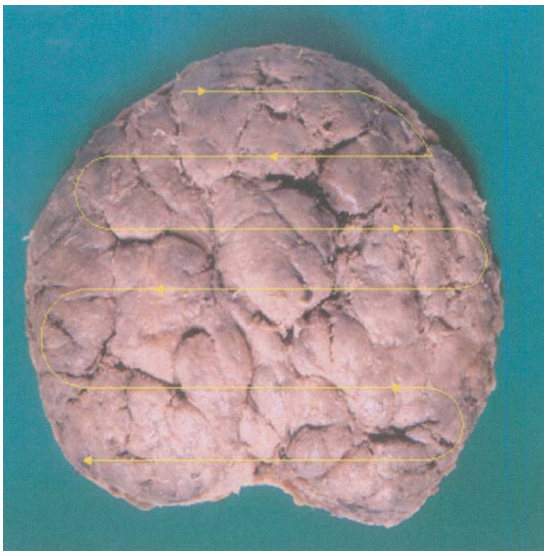

Fig 3. Photograph of the maternal surface of a placenta showing the procedure of counting the number of cotyledons.

Results

In this study, Table I shows that the placental diameter, weight and volume had significantly higher values in GDM group when compared to control and PIH groups. Again, number of cotyledons was more in GDM group than control and PIH groups and differs significantly from PIH group. The mean values of the placental thickness were non-significantly higher in PIH group than other two groups. Fig 4 presents frequency curves that shows frequency distribution of placental weight (gm) in three groups. Here curve for the GDM group shows a slight shift to the right while the curve for the PIH group is shifted to the left. This indicates that incidence of heavy weighted placentas is more in the GDM group than that of PIH group.

Fig 5 shows frequency curves for placental volume in the GDM and PIH groups that compare the curve for the control group. The curve for the GDM group shows shifts to the right while the curve for the PIH group is shifting to the left.

Table I: Macroscopic variables of the preterm placenta in three groups (sample, n =22 in each group)

Variable	Control (C) (n = 22)	GDM (G) (n = 22)	PIH (P) (n = 22)	Significance between groups
Diameter (cm)				
Range	7.75-22.50	12.50-22.50	9-20	C vs G: *
Mean ± SD	(17.41 ± 2.97)	(19.20 ± 2.30)	(16.32 ± 2.7)	G vs P: **
Thickness (cm)				
Range	0.57-2.37	0.70-2.20	0.70-2.03	
Mean ± SD	(1.36 ± 0.53)	(1.33 ± 0.45)	(1.60 ± 0.34)	
No of cotyledons				
Range	12-24	8-26	12-22	
Mean ± SD	(17.95 ± 3.43)	(18.55 ± 5.07)	(16.27 ± 3.00)	G vs P :*
Weight (g)				
Range	150-580	151-580	140-454	C vs G: *
Mean ± SD	(361.68 ± 112.62)	(417 ± 97.32)	(312.68 ± 77.09)	G vs P: **
Volume (mL)				
Range	125-500	140-650	120-432	C vs G: *
Mean SD	(341.82 ± 103.95)	(415.00 ± 99.37)	(285.09 ± 81.04)	G vs P :***

The Post Hoc option of analysis of variance (ANOVA) was done to compare each group with other groups for each variable. *, P < 0.05; **, P < 0.01; ***, P < 0.001

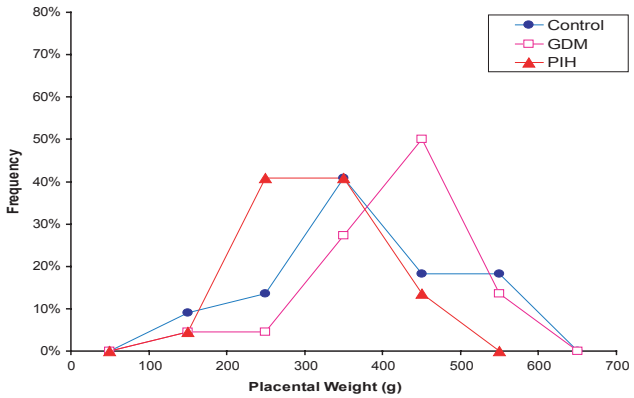

Fig 4. Frequency curves for placental weight in the GDM and PIH groups compared to the curve for the control group.

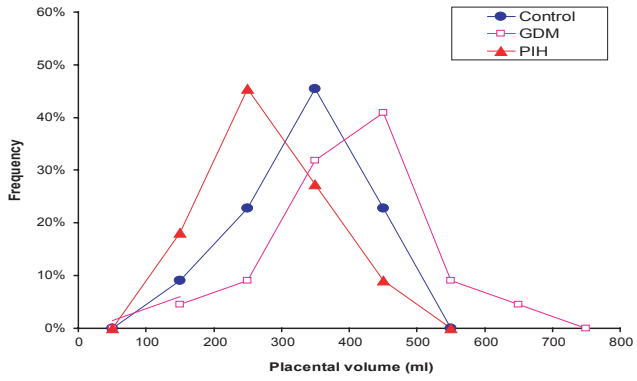

Fig 5. Frequency curves for placental volume in the GDM and PIH groups compared to the curve for the control group.

Discussion

In morphological study of preterm placenta in the two pregnancy complicated disorders, there were significantly larger placental diameter, weight and volume in GDM group than in PIH group. The increased placental weight and volume in diabetic mothers were also stated by various authors.[6-9,13-17] Mayhew et al[17] demonstrated that the placental weight was due to hyperplasia throughout the gestation that was reflected by higher DNA contents. Again Boyed et al[18] and Desoye & Shafrir[19] stated that the increased placental growth was to be a consequence of a co-existing metabolic or endocrine effect of hyperinsulinaemia. Again, Luis A, Cibilis[4] observed that the placenta from hypertensive patients were significantly smaller than normal that was found in present study. The total volume of the placenta in diabetic mothers was on average 12% larger than that of the non-diabetics stated by Boyd et al.[18] On the other hand, Aherne W and Dannill MS[20] observed that the mean placental volume in PIH group was significantly lower than the normal value. In the present study, the mean value of placental volume was significantly higher in GDM than that of the PIH and control groups. However, the increased diameter and increased number of cotyledons were found in GDM group that may be the consequence of the increased volume of the

parenchyma (20% increase) and increased surface area of villi in this group.

Considering the findings in this study, it is difficult to establish a clear cut correlation about placental changes in diabetic and hypertensive mothers during pregnancy. However, increased placental weight, volume and diameter found in gestational diabetic mother have supported that these changes may be a long term compensatory mechanism, aiming to secure a sufficient nutrient supply to support the growth of the foetus. But the metabolic and biochemical abnormalities present in mother and foetus in these two pregnancy induced disorders are also important factors to be considered when studying the placenta. It would be logical to suggest that the postnatal examination of the placenta can yield information that may be important not only for immediate and late management of the mother and neonate but it may also help to prevent any adverse maternal or foetal outcome.

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