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Original Article

EFFECT OF GESTATIONAL DIABETES MELLITUS ON GROSS MORPHOLOGY OF PLACENTA: A COMPARATIVE STUDY

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ABSTRACT

Background: The fetus, placenta and mother constitute a triad of contributors to pregnancy outcome. When pregnancy is complicated by a medical problem like, diabetes mellitus which affects maternal health, architecture and functions of the placenta may even jeopardize the fetal normalcy. The placenta being the bridge between maternal and fetal activities, considered as a window through which maternal dysfunctions and their impacts on fetal well being can be understood.
Aim: The aim was to study gross morphology of placentae of women with gestational diabetes mellitus and to compare the results with normal pregnancies.
Methods: It was an observational study. After due approval from institutional ethics committee, 40 placentae from pregnant women clinically diagnosed with gestational diabetes mellitus and 40 placentae from uncomplicated normal pregnant women were collected from labour room and operation theatre of department of obstetrics and gynaecology of government medical college hospital in Jaipur (Rajasthan). Confirmed gestational diabetic cases were selected purposively while controls were taken sequentially. Gross morphological features of each placenta were recorded. The statistical methods used were unpaired 't' test and chi square test.
Results: The results showed that weight, diameter, surface area, central thickness and number of cotyledons of placentae from diabetic mothers were significantly more than placentae from normal uncomplicated pregnancies, while no significant differences were observed in shape and site of umbilical cord insertion.
Conclusion: The gross morphology of placentae with gestational diabetes mellitus significantly differs from normal pregnancies which may be associated with alteration in physiological functioning of placenta and ultimately fetal outcome.
KEY WORDS: Gestational Diabetes Mellitus, Morphology, Placenta, Pregnancy.

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INTRODUCTION

Pregnancy is a diabetogenic state by virtue of various physiological changes which cause insulin resistance. In normal pregnancy, glucose tolerance decreases by third trimester, though plasma levels of insulin increase. Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy [1].

Currently, 4 to 11.6% of India's urban population and 3% of rural population above the age of 15 have diabetes. India has been called "the diabetes capital of the world" and it is estimated that 41 million Indians have the disease and every fifth diabetic in the world is an Indian [2]. About 2% to 5% of the total pregnancies may be affected by diabetes mellitus. Among pregnancies complicated by diabetes mellitus, about 65% cases involve gestational diabetes mellitus, whereas 35% cases are associated with pre-existing diabetes mellitus [3]. Few other studies carried out in different part of India, found the prevalence of gestational diabetes mellitus ranges from 6.6% to 7.1% [4, 5].

Placenta is a vital organ for fetal development and is a mirror of maternal and fetal status. It derived from both fetal and maternal tissues, the maternal portion being the decidua basalis and the fetal portion is chorion frondosum [6]. The fetus, the placenta and the mother constitute a triad of contributors to pregnancy outcome [7].

So, as a mirror, placenta reflects the intra-uterine status of the fetus. Its metabolic functions are complex and it undergoes changes continuously throughout gestation in weight, structure, shape and function in order to support prenatal life [8]. In GDM, when the intra-uterine environment for fetus become hostile, the placenta tries to exert its reserve capacity by changing its morphological structure, as well as some pathological changes occur that are compounded principally of some disturbances in its normal rate of maturation [9].

Therefore examination of gross morphology of placenta in cases of gestational diabetes mellitus provides vital information to both obstetricians and neonatologists.

MATERIALS AND METHODS

It was a prospective comparative study, conducted in department of Obstetrics and Gynaecology at a government medical college hospital in Jaipur (Rajasthan) between April 2012 and September 2014. Due clearance was taken from the institutional ethical committee before proceeding with the study. Each respondent was explained the purpose of the study prior to the administration of tools of data collection and informed consent was obtained. The confidentiality of the information was assured. The study population included 40 pregnant women clinically diagnosed with gestational diabetes mellitus, who had undergone vaginal delivery or caesarean section. An equal number of controls were taken for matching, who were considered to be at a low obstetric risk. These women had no maternal complications during pregnancy and their obstetric and laboratory tests were normal.

A pre-structured and pre-tested proforma was used to collect the data. Personal details of mothers like name, age and address were recorded. Social history regarding habits of mothers like smoking, tobacco chewing and consumption of alcohol were taken. Detailed obstetric history regarding parity, period of gestation, bad obstetric history in past, type of pregnancy (singleton or multiple), mode of delivery and abruptio placentae was recorded. Medical history regarding anaemia, jaundice, malnutrition, cardiovascular disease, cerebro-vascular disease, respiratory disorders, psychiatric illness and any other major illness was taken and recorded. A general physical examination was done for anaemia, jaundice and nutritional status of mothers. Blood pressure, weight and relevant investigations were recorded from bed head tickets.

The placentae with attached membranes and umbilical cord were collected soon after delivery and washed in running tap water to clean all blood. Surface dried between blotting papers and examined for morphological characteristics like shape, type of insertion of umbilical cord, numbers of cotyledons. The membranes were trimmed and the cord was cut at about 2 centimeters from its insertion. The placenta was then weighed using baby weighing machine. The central thickness was measured by long knitting needle. Two diameters of the placenta were measured with the non stretchable measuring tape and the mean of the two was calculated. The maternal surface area of the placenta was calculated by using the formula πr^2. The evaluation of macroscopic placental parameters was performed according to protocols published by Benirsckhe [10].

Inclusion criteria: Pregnant women with age between 20-38 years, para 1 to 5, gestational

age between 37-42 weeks, deliveries by either vaginal route or caesarean section with singleton pregnancy were included. The control group comprised pregnant women who did not experience complications during pregnancy and who had normal laboratory tests while study group comprised pregnant women with clinically confirmed gestational diabetes mellitus.

Exclusion criteria: Pregnant women who did experience any complication during pregnancy like hypertension, hypothyroidism, anaemia, abruptio placentae, multiple pregnancies, jaundice, maternal malnutrition, cardiovascular disease, cerebro-vascular disease, psychiatric illness, respiratory disorders, tobacco abuse, smoking, alcoholism etc. were excluded from study.

Statistical analysis: The data was entered on Microsoft excel 2010 and analyzed. The results for each parameter (numbers and percentages) for discrete data and average (mean ± standard deviation) for continuous data are presented in Tables and Figures. Proportions were compared using Chi-square test of significance. The student 't' test was used to determine whether there was a statistical significant difference between control and study group. A *P*-value of less than 0.05 was considered to be statistically significant.

RESULTS

It was observed in present study that the mean age in control group was 26.33 ± 4.33 years while it was 26.88 ± 3.67 years in GDM group (Table-1). Majority of subjects (42.5%) in control group were in the age group 20-24 years followed by 25-29 years (32.5%) while in GDM group maximum cases were in the age group 25-29 years (47.5%) followed by age group 20-24 years (30%). Age group 30-34 years and age group 35 years and above contained considerable low number of cases in both groups (Table-2).

Table 1: Distribution of characteristics of study subjects.

Characteristic	Control (Mean ± SD)	GDM (Mean ± SD)
Age	26.33 ± 4.33 Years	26.88 ± 3.67 Years
Weight	54.28 ± 6.10 kilograms	59.78 ± 4.24 kilograms
Height	1.57 ± 0.05 meters	1.58 ± 0.04 meters
BMI	22.05 ± 1.80 Kg/m^2	24.02 ± 1.47 Kg/m^2

Table 2: Distribution of subjects according to age.

Age (in Years)	Control n (%)	GDM n (%)
20-24	17 (42.5)	12 (30)
25-29	13 (32.5)	19 (47.5)
30-34	7 (17.5)	8 (20)
35 and above	3 (7.5)	1 (2.5)
Total	40 (100)	40 (100)

In controls majority of cases were in para-2 (40%) followed by para-1 (37.5%), while in GDM group majority of cases were in para-1 (42.5%) followed by para-2 (35%). Para-3 cases were 17.5% in controls while 20% in GDM group. Para-4 cases were 5% in controls and 2.5% in GDM group (Table-3).

Table 3: Distribution of subjects according to parity.

Parity	Control n (%)	GDM n (%)
Para-1	15 (37.5)	17 (42.5)
Para-2	16 (40)	14 (35)
Para-3	7 (17.5)	8 (20)
Para-4	2 (5)	1 (2.5)
Total	40 (100)	40 (100)

The mean weight of controls was 54.28 ± 6.10 kilograms and 59.78 ± 4.24 kilograms in GDM group; while the mean height of control group was 1.57 ± 0.05 meters and 1.58 ± 0.04 meters in GDM group. The body mass index (BMI) of control group was 22.05 ± 1.80 Kg/m^2 and 24.02 ± 1.47 Kg/m^2 in GDM group (Table-1).

The mean placental weight in control group was 397.50 ± 42.29 grams, while it was more in GDM group (426.25 ± 48.02 grams) and the difference was highly significant ($p < 0.01$). The mean number of cotyledons in control group was 16.93 ± 2.49, while it was higher in GDM group (18.38 ± 2.27). The difference was significant ($p < 0.05$). The mean central thickness in control group was 1.96 ± 0.23 centimeters, while it was significantly more ($p < 0.05$) in GDM group (2.12 ± 0.35 centimeters). The mean placental diameter was 15.40 ± 1.34 centimeters in

Table 4: Placental morphometry between gestational diabetic and normal pregnancies.

Parameter	Controls N=40 (Mean ± SD)	GDM N=40 (Mean ± SD)	't' test	P value
Placental weight (in grams)	397.50 ± 42.29	426.25 ± 48.02	2.842	0.006
Number of cotyledons	16.93 ± 2.49	18.38 ± 2.27	2.722	0.008
Central thickness (in cms)	1.96 ± 0.23	2.12 ± 0.35	2.416	0.018
Placental diameter (in cms)	15.40 ± 1.34	16.33 ± 1.14	3.343	0.001
Placental surface area (in cm^2)	187.61± 32.73	210.39 ± 28.98	3.296	0.001

control group and 16.33 ± 1.14 centimeters in GDM group and the difference between both groups was highly significant ($p < 0.01$). The mean placental surface area was 187.61 ± 32.73 cm^2 in control group while it was higher in GDM group (210.39 ± 28.98 cm^2). The difference between two groups was statistically highly significant ($p < 0.01$) (Table-4).

In control group 40% placentae were of round shaped and 60% were of oval shaped, while in GDM group 35% of placentae were round shaped and 65% were oval shaped. The difference was not significant ($p > 0.05$). In control group umbilical cord insertion was central in 27.5%, eccentric in 55% and marginal in 17.5% of placentae while in GDM group it was central in 25%, eccentric in 60% and marginal in 15% of placentae. The difference between two groups was again not significant ($p > 0.05$) (Table-5).

Table 5: Placental morphology between gestational diabetic and normal pregnancies.

Parameter	Controls N=40 n (%)	GDM N=40 n (%)	Chi square (df)	P value
Placental shape				
Round	16 (40)	14 (35)	0.53 (1)	0.817
Oval	24 (60)	26 (65)		
Insertion of umbilical cord				
Central	11 (27.5)	10 (25)	0.211 (2)	0.9
Eccentric	22 (55)	24 (60)		
Marginal	7 (17.5)	6 (15)		

Fig. 1: Showing the Round Shaped placenta.

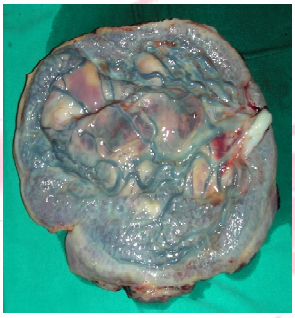


Fig. 2: Showing the Oval Shaped placenta.

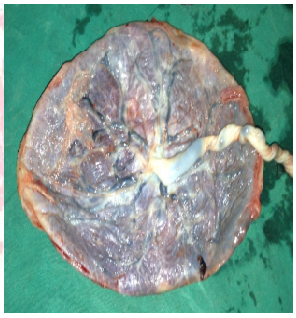


Fig. 3: Showing umbilical cord Insertion-Central.

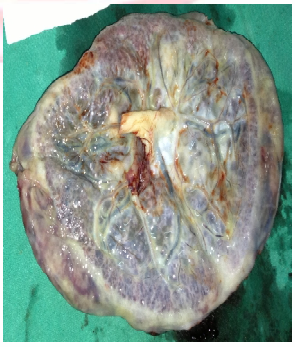


Fig. 4: Showing umbilical cord Insetion-Eccentric.

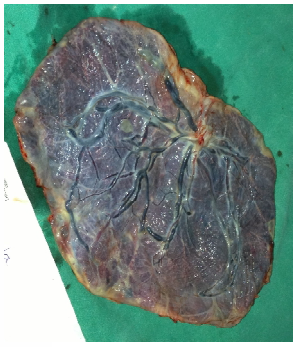


Fig. 5: Showing umbilical cord Insetion-Marginal.

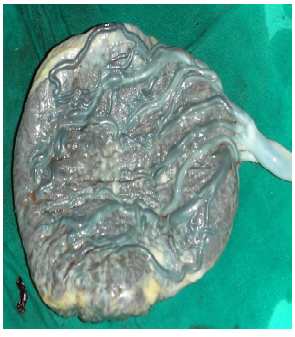
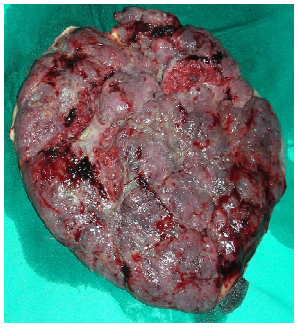


Fig. 6: Showing cotyledons.



DISCUSSION

The placenta forms a functional unit between the mother and the fetus that plays pleiotropic role during fetal growth. Therefore, any pathological event that concerns the mother or the fetus will influence the normal function of the placenta, occasionally resulting in morphological and histological change. These abnormalities of the placenta may lead to adverse fetal outcome [11].

The weight of placenta is an important and functionally significant parameter as it is related to villous area and fetal metabolism. In the present study, the mean placental weight in GDM group was more as compared to control group and this difference was found highly significant ($p < 0.01$). Similar findings were reported in previous studies by Ashfaq et al (2005) [12] in Karachi, Pakistan, Verma et al (2010) [13] in New Delhi, Akhter et al (2010) [14] in Dhaka, Bangladesh, Chowdhury et al (2011) [15] in Dhaka, Bangladesh and Saha et al (2014) [16] in Kolkata. The weight gain in placentae of diabetic mothers may be attributed to macrosomia and compensatory hyperplasia. Macrosomia affects the fetus and fetal part of placenta, i.e. chorionic plate and all types of villi. This macrosmia may be attributed to fetal hyper insulenemia in response to hyperglycaemia in fetuses of diabetic mothers [17].

In the present study, the mean numbers of cotyledons in GDM group were more as compared to control group and this rise was found highly significant ($p < 0.01$). Similar results were found in a study done by Akhter et al (2010) [14] in Dhaka, Bangladesh, where they compare preterm placentae of normal with diabetic mothers. The mean central thickness of placentae in GDM group was more as compared to control group and this rise was found significant ($p < 0.05$). Similar results were found in studies by Ashfaq et al (2005) [12] in Karachi, Pakistan and Saha et al (2014) [16] in Kolkata. The mean placental diameter in GDM group was more as compared to control group and this rise was found highly significant ($p < 0.01$). Similar results were found by Ashfaq et al (2005) [12] in Karachi, Pakistan and Saha et al (2014) [16] in Kolkata in their study, where they compare placentae of normal with diabetic mothers. The mean placental surface area in GDM group was more as compared to control group and this rise was found highly significant ($p < 0.01$). Similar result was observed by Saha et al (2014) [16] in Kolkata in their study, where they compare placentae of normal with diabetic mothers. In present study, majority of placentae in both groups were oval shaped followed by round shaped. The shape of placentae did not found any significant association ($p > 0.05$). As all subjects were apparently healthy and there was no evidence of malnutrition, may be the cause for normal shape of placentae. Similar findings were observed by Ashfaq et al (2005) [12] in Karachi, Pakistan where they found that shape of placentae in diabetic and control groups were roughly oval or round except one placenta in diabetic group which was bilobed. The insertion of umbilical cord in placentae of GDM mainly had eccentric or central insertion while few had marginal insertion. The difference when compared to control group was found not significant ($p > 0.05$). Similar results were found in previous studies by Ashfaq et al (2005) [12] in Karachi, Pakistan, Verma et al (2010) [13] in New Delhi and Saha et al (2014) [16] in Kolkata.

CONCLUSION

From this study we conclude that placentae of women with gestational diabetes mellitus show significant variation in gross morphology that can be associated with impaired function of placenta, leading to adverse perinatal outcome.

Conflicts of Interests: **None**

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