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Research Article

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

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ABSTRACT

Background: GDM is a hyperglycemic state observed during pregnancy. It a matter of global concern due to its increasing prevalence and health burdern it imposes on maternal and fetal health. Placenta, the reflection of intrauterine environment in which the fetus grows, shows significant alterations in its gross morphology due to GDM. This will ultimately increase risk of unfavourable pregnancy outcomes. **Aim:** The main of this study was to assess and compare the gross morphology of placental specimen obtained from females with GDM and healthy females. **Methods:** This study included 150 healthy pregnant females and 150 females with GDM. Basis details including medical history was taken from each participant. After parturition, the placental specimen were collected, cleaned and gross morphometric features like weight, thickness, circumference, diameter, volume, area and feto placenta ratio were evaluated. The specimens were then preserved in formalin for 3-5 days after which the number of cotyledons was counted. The data was nalysed using SPSS 20. **Results:** It was observed that the placental morphometrical features like weight, volume, area, diameter, thickness, area and fetoplacental ratio were significantly high in placental specimen from GDM mothers compared to healthy mothers. Likewise, the number cotyledon in diabetic placenta was significantly high ($p<0.001$). **Conclusion:** this study shows the presence of abnormal placental morphometry in GDM that induced by hyperglycemia and can result in several associated health risks to fetus. Hence adequate control of glycemia in gestational state is suggested to ensure healthy pregnancy.

INTRODUCTION

Due to several physiological alterations that can result in insulin resistance pregnancy may be considered as transient diabetogenic stage. Normally, there is decrease in glucose tolerance by third trimester, though the level of circulating insulin increases. Gestational diabetes mellitus, also abbreviated as GDM, is glucose intolerance that may develop with onset of pregnancy of may be first diagnosed during pregnancy [1]. About 65% of diabetes complicated pregnancy involves GDM [2]. According to the different studies conducted in various regions of India, GDM prevalence ranges from 6.6-7.1% [3,4]. The variation in the prevalence rate could be attributed to difference in diagnostic criteria that have been modified over times. GDM results in adverse obstetric outcomes like preterm labor, macrosomia, caesarean delivery, shoulder dystocia etc [5]. Additionally the newborn babies who are exposed to GDM in intrauterine life are at increased risk of obesity, diabetes and intellectual disabilities later [6,7].

Placenta is crucial for fetal development and gives information about maternal and fetal heath status. Placenta consists of tissues form both fetal and maternal origin. The maternal portion present is decidua basalis while the fetal portion present is chorion frondosum [8]. The metabolic functions of placenta are very complex and they are subjective to continuous change throughout gestational period. The changes occuring in placenta are evident in weight,shape, volume, surface area, diameter and fetoplacental ratio [9]. The fetus is imposed to the hostile intrauterine environment created by GDM. In such case, placenta attempts to adapt to the hostile environment by producing alterations in its morphological features so that the demands of growing fetus is not compromised. These disturbances are principally seen as the disturbances in the normal rate of placental maturation [10]. Therefore, gross examination of placental morphometry in GDM provides vital information relative to fetal and maternal health to both neonatologists and obstetricians so that any untoward health burdens can be managed before their complete budding.

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MATERIALS AND METHODS

This prospective case control study was carried out in the Department of Physiology. After the ethical approval the study was commenced including 150 patients of GDM and 150 control group (healthy pregnant females). The relevant information regarding age, height, weight, gestational age, parity, mode of delivery, any previous illness etc were recorded in a predesigned performa.

Inclusion criteria

- Pregnant women
- Primipara or multipara females
- Females without history of alcohol intake and smoking
- Females willing to participate entire period of gestation and consenting to get their pregnancy and neonatal outcomes assessed

Exclusion criteria

- Pregnant females more than 40 years
- Pregnant females not willing to participate
- Pregnant females with thyroid disorders, cardiovascular disease, pulmonary disorders, neurological disorders, pre-existing diabetes mellitus with associated complications
- Females with preterm delivery (<37 weeks), post term delivery (>40 weeks) fetal malformations and retarded intrauterine growth.
- Females who conceived via infertility treatment

Post delivery, the placenta with umbilical cord was collected and washed with water to remove blood. Then the placental surface was dried with blotting paper followed by assessment of its morphometric features like shape, number of cotyledons and insertion mode of umbilical cord. After that the membranes were trimmed off followed by the removal of umbilical cord by making a cut 2 cm away from its insertion site on placenta. The placental thickness, diameter, circumference, weight, volume, surface area and number of cotyledons were measured as follows:

1. Weight was measured in grams (gm) by electronic weighing balance.
2. Volume was measured in mL by water displacement method.
3. Thickness was measured in cm using graduated needle. The needle was inserted in placenta at center, at margin and between the margin and the center. The mean of three readings was considered.
4. Diameterwas measured in cm by using measuring tape. The maximum diameter (d1) and minimiun minimum diameter (d2) were measured. The mean value of d1 and d2 was considered.
5. Areaof placenta was calculated as:
1. Surface area (A)= (π/4) X d1 X d2 [135]
6. Circumference was calculated as,

Circumference = π X d

The cotyledon number was estimated after fixing the placental sample in formalin for 3-5 days. It results in hardening of placental tissue so that application of even slight pressure on the fetal surface makes the cotyledons prominent and separate from the adjacent cotyledons.

Statistical analysis: The data was analysed using statistical software, SPSS 20. The comparative analysis between case and control groups was done using Mann Whitney test. A p-value < 0.05 showed statistical significance.

RESULTS

The mean age of women in control group was 30.1±4.1 and case group was 29.8±4.4. It was insignificant statistically (p>0.05). Likewise the mean BMI and gestational age respectively were 22.8±2.4 and 38.1±2.2 in control group while 25.6±3.6 and 37.3±1.5 in case group. Significant result was obtained in case of BMI only (table 1, p<0.001). The rate of caesarean delivery was high in females with GDM (22%, table 2). It was observed that 38% of the women in control group were primipara and 62% were multipara. Similarly, 41% of the women with GDM were primi-para and 59% r were multi-para (table 3). The rate of preterm delivery was high in GDM cases. It was 15% in GDM cases compared to 10% in control group (table 4). In cases of placental shape circular, oval irregular and round shaped placenta was found in 41%, 17%, 29%, and 13% respectively while the same were 49%, 20%, 22% and 9% in the GDM case group (table 5, p<0.001). On comparison of placental weight, thickness, diameter, circumference, volume and area, it was found that all the parameters were significantly increased in the placental specimen from GDM mothers (table 6). Regarding type of umbilical cord insertion, 46%, 15.3%, 30.7% and 8% of the placental specimen from normal mother in control group showed central, marginal, intermediate and velamentous type of insertion respectively while they were 42%, 24.7%, 24% and 9.3% while in the placental specimen from GDM mothers (table 7).

Table 1 Comparison on demographic variables between control and GDM cases

Parameter	Control	Case (GDM)	p
Age	30.1±4.1	29.8±4.4	>0.05
BMI	22.8±2.4	25.6±3.6	<0.001**
Gestational age	38.1±2.2	37.3±1.5	<0.05

Table 2 Comparison mode of delivery between control and GDM cases

Mode of delivery	Control	Case (GDM)
Caesarean	14% (21)	22% (33)
Vaginal	86% (129)	78% (117)

Table 3 Comparison of parity between control and GDM cases

Parity	Control	Case (GDM)
Primi para	38% (57)	41% (61)
Multi para	62% (93)	59% (89)

Table 4 Comparison delivery outcome between control and GDM cases

Outcome	Control	Case (GDM)
Pre-term	10% (15)	15% (23)
Term	88% (132)	79% (118)
Post term	2% (6)	6% (9)

Table 5 Comparison of shape of placenta between control and GDM cases

Shape of placenta	Control	Case (GDM)
Circular	42% (61)	49% (74)
Oval	17% (26)	20% (30)
Irregular	29% (44)	22% (33)
Round	13% (19)	9% (13)

Table 6 Comparison ofmorphometric parameters of placenta between control and GDM cases

Shape of placenta	Control	Case (GDM)	p
Weight	459.88±81.1	503.79±96.06	<0.001
Thickness	1.84±0.73	2.85±0.87	<0.001
Diameter	16.23±3.16	17.77±2.13	<0.001
Circumference	51±9.92	55.85±6.71	<0.001
Volume	377.72±70.78	436.94±83.25	<0.001
Area	214.7±82.31	251.68±61.48	<0.001
Fetoplacental ratio	5.71±0.98	6.64±1.3	<0.001
No. of cotyledons	13.41±3.09	18.3±3.94	<0.001

Table 7 Comparison of mode of insertion of umbilical cord between control and GDM cases

Group	No.	Mode of insertion of Umbilical cord (%/n)			
		Central	Marginal	Intermediate (eccentric)	Velamentous
Control	150	46% (69)	15.3% (23)	30.7% (46)	8% (12)
Case	150	42% (63)	24.7% (37)	24% (36)	9.3% (14)

DISCUSSION

The placenta being essential for fetal growth, anypathological alteration in its structure and functionality influences the obstetric outcomes. Inpresent study, majority of the placental specimen obtained were circular in shape both the control (42%) and case group (49%). In the study of Saini P*et al* [9], the common placental shape observed was oval which was similar to the result of Ashfaq M *et al* [10] who found majority of oval or round shaped placenta. In their study, one placental specimen from diabetic group showed bilobed structure. When umbilical cord insertion type was analysed, it was observed that central insertion was common type in both the group of participants (46% in control and 42% in cases). This was in accordance with the results of Muthuprasad P*et al*[11] who showed central insertion in 60% of placental specimen while contrasted the result of Gunapriya R*et al* [12], who showed eccentric type of insertion as the common mode.

When placental morphometry (weight, diameter, thickness, circumference, volume and area) were compared, it was found that all these morphometric parameters were significantly high in the placental specimen from GDM mothers. Similar results were documented in the previous studies of Ashfaq M*et al* [10], Verma R*et al* [13] Akhter F*et al*[14], Chowdhury AHM*et al*[15] and Saha S*et al*[16]. The increase in placental weight in GDM is due to macrosomia and hyperplasia that occur as a compensatory phenomenon in response to hyperglycemia.

According to Mayhew TM *et al* [17] placental weight gain occurs due to hyperplasia that is reflected by hyperinsulinemia andhigher DNA contents. As per Magee TR *et al* [18], increase in placental mass is significantly associated with reduced apoptosis of trophoblast in GDM.Increase in placental weight causes simultaneous increase in other morphological parameters also (volume, thickness, diameter and cotyledon numbers). In the present study, the number of cotyledon was significantly high in placenta obtained from GDM mothers compared to control group. The results were in line with that of Akhter F*et al*[14]. Significant increase in placental and volume correlates well with the increase in cotyledon number.

In the present study there was increase in fetoplacental ratio in case of GDM compared to control group. Increased fetoplacental ratio signifies the adaptive mechanism adopted by placental tissues to cope up with unfavourable maternal environment. In GDM, there is reduced placental transfer of oxygen and nutrients to the growing fetus because of which the placenta undergoes compensatory hypertrophy in attempt supply adequate oxygen and nutrients to fetus.Increasedfetoplacental ratio and other morphological parameters of placenta indicates disturbances in fetal growth [19] thatincreases the possibility of intrauterine fetal death [20]. Further, infants from GDM are at increased risk of hypoglycaemia, respiratory distress, congenital malformations, macrosomia, intrauterine growth retardation (IUGR) etc [21]. Hence, adequate management of GDM with standard screening methodology is required.

CONCLUSION

From this study it is apparent that alterations in placental morphometry are significantly associated with GDM. Such alterations lead to unwanted perinatal outcomes like increased risk of feral mortality or the risks of various compications like hypoglycaemia, macrosomia, congenital disorders, shoulder dystocia etc. Therefore there is necessity to maintain good glycemic control during gestational phase to maintain normal pathophysiology of placenta which will ultimately facilitate development of healthy fetus in healthy intraunterine environment.

Conflict of interest: Nill

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