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Original Research Article

Placental Morphometry in Gestational Diabetes Mellitus: A Cross-Sectional Study

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Abstract: 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: To compare the gross morphometric characteristics of placentae from mothers with GDM and those with normal pregnancies. ***Methods:*** A hospital-based comparative cross-sectional study was conducted on 150 placentae—75 from GDM and 75 from healthy control were collected immediately after delivery with prior consent. Morphometric parameters including placental weight, diameter, thickness, and volume were measured using standard anatomical techniques. Statistical analysis was performed using SPSS version 25.0 ***Results***: On gross examination, of 150 placentas (75 from the control group and 40 from the GDM group), those from the GDM group showed significantly higher placental weight, diameter, volume, thickness, and lower foeto-placental ratio than the control group. The p-value for all these parameters was observed to be <0.001. ***Conclusion:*** This study shows the presence of abnormal placental morphometry in GDM that induced by hyperglycemia and can result in compromised functional efficiency and several health associated risks to fetus. Hence adequate control of glycemia in gestational state is suggested to ensure healthy pregnancy.

Keywords: Gestational Diabetes Mellitus, Placenta, Morphometric analysis, Feto-placental ratio, birth weight.

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.

MATERIALS AND METHODS

A total of 150 placentae were collected immediately after delivery 75 from mothers with GDM and 75 from healthy normoglycemic mothers from Geetanjali Medical College & hospital.

The study aimed to compare placental morphometric changes between Gestational Diabetes Mellitus (GDM) and those with normal pregnancies.

Study design: A comparative cross-sectional study

Inclusion Criteria:

- Pregnant women diagnosed with GDM based on the **Oral Glucose Tolerance Test (OGTT)** following standard International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. (11)
- Age between 20–35 years.

Exclusion Criteria:

- Pregnancies complicated by pre-existing diabetes, hypertension, pre-eclampsia, eclampsia, or chronic systemic illness.
- Intrauterine growth restriction, or congenital fetal anomalies.
- Placentae showing gross post-delivery damage or incomplete membranes.

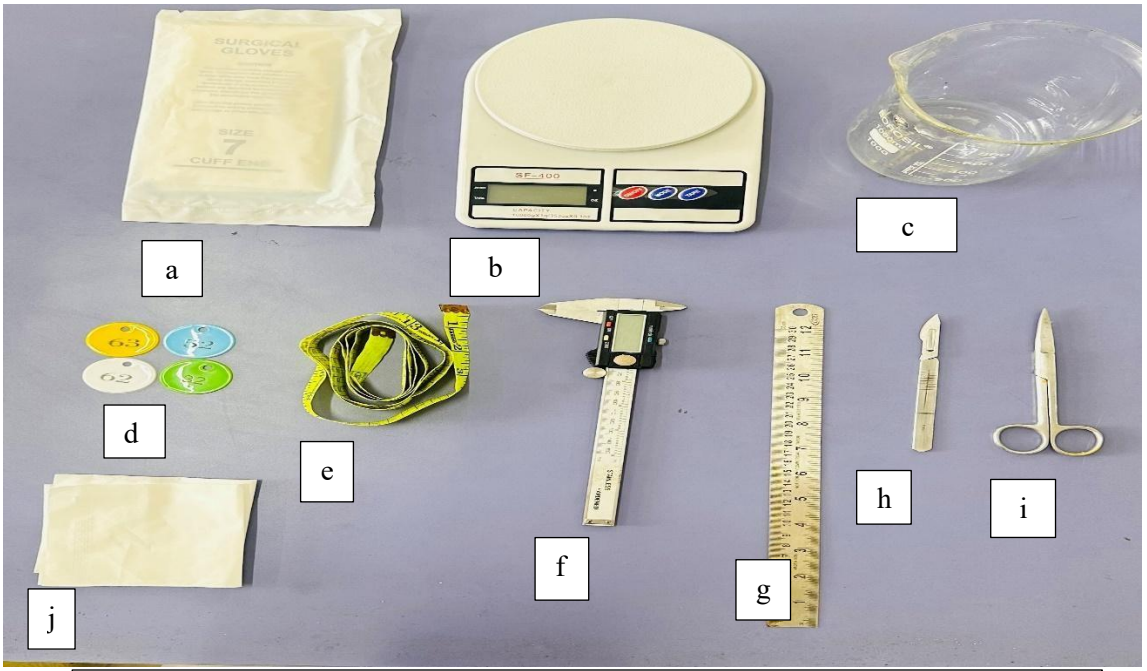

Fig 1. a- gloves, b- weighing balance, c- graduated glass beaker, d- tags, e- measuring tape, f- vernier caliper, g- metallic scale, h- scalpel, i- scissors, j- blotting paper

Collection and Examination of Placentae

Immediately after delivery, each placenta was collected, cleaned of blood clots, and washed under running tap water

and tagged. The umbilical cord was cut about 5 cm from its placental insertion. Morphometric measurements included

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 vernier caliper.
4. Diameter was measured in cm by using measuring tape. The maximum diameter (d1) and minimum diameter (d2) were measured which were at right angles to each others. The mean value of d1 and d2 was considered.
5. Area of placenta was calculated as:
   Surface area (A)= πr^2
6. Circumference was calculated as,
   Circumference = π X d
7. The feto-placental ratio: was obtained by dividing fetal weight by placental weight.
   The birth weight was recorded on balance machine in kgs.
8. Number of Cotyledons: The placenta was placed with the maternal side facing upwards on a flat surface. Then counting was started from one end and ended at another end. The total number of cotyledons was recorded.

The evaluation of macroscopic placental parameters was performed according to protocols published by Benirsckhe [12].

Statistical Analysis

Data were compiled and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent Student's t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

Morphometric evaluation revealed a marked increase in placental weight (612.2 ± 126.5 g vs 526.9 ± 102.9 g), thickness (2.83 ± 0.67 cm vs 2.31 ± 0.63 cm), and volume (593.93 ± 122.7 mL vs 511.20 ± 99.8 mL) in GDM compared to controls ($p < 0.001$). The feto-placental ratio was significantly lower in diabetic pregnancies (5.50 ± 1.23 vs 6.23 ± 1.34; p = 0.001), indicating reduced placental efficiency despite hypertrophy. No significant difference was noted in birth weight between the groups.

Table 1: Comparison of Placental Morphometric Parameters Between GDM and Normal Pregnancies

Parameter	GDM (Mean ± SD)	Control (Mean ± SD)	t value	p value
Placental weight (g)	612.2 ± 126.5	526.9 ± 102.9	4.53	0.000*
Placental diameter (cm)	21.30 ± 2.10	18.37 ± 2.40	1.25	0.212
Placental circumference (cm)	59.68 ± 7.04	57.70 ± 7.53	1.66	0.099
Placental area (cm²)	287.38 ± 66.89	269.44 ± 68.17	1.63	0.106
Placental volume (mL)	593.93 ± 122.7	511.20 ± 99.8	4.53	0.000*
Placental thickness (cm)	2.83 ± 0.67	2.31 ± 0.63	4.86	0.000*
Number of cotyledons	16.9 ± 4.9	17.8 ± 4.3	0.53	0.59
Feto-placental ratio	5.50 ± 1.23	6.23 ± 1.34	3.49	0.001*
Birth weight (g)	3242.4 ± 410.0	3188.2 ± 447.7	0.77	0.441

$p < 0.05$ considered statistically significant

Fig. 2 Foetal surface with cord insertion

Fig. 3 Maternal surface with cotyledons

Fig. 4 Measuring Weight

Fig. 5 Measuring thickness

Fig.6 Measuring Diameter

Fig.7 Measuring Volume

DISCUSSION

The placenta in Gestational Diabetes Mellitus (GDM) exhibits characteristic structural and functional alterations that mirror the impact of maternal hyperglycemia on the fetoplacental unit. The present study aimed to assess and compare the morphometric features of placentae from diabetic and normoglycemic pregnancies, providing insight into placental adaptation and compensatory mechanisms.

Morphometric Characteristics

Quantitative analysis revealed that placental weight, thickness, and volume were significantly increased in the GDM group compared to controls ($p < 0.001$). These results are consistent with multiple independent studies. Souza et al. 2022, found increased placental weight and diameter in GDM, indicating compensatory hypertrophy.(13) Likewise, Singh et al. 2020, observed statistically significant increases in placental weight, volume, and thickness in GDM, reflecting increased villous capillarization.(14) Carrasco-Wong et al,2020, demonstrated that GDM placentae show enhanced vascular proliferation and stromal expansion, leading to a higher volume an area without proportional improvement in

efficiency.(15) In agreement, the present study recorded a significantly lower feto-placental ratio among diabetic mothers, indicating reduced placental efficiency—a pattern also documented by Molitierno 2025 & Dubova 2011 (16,17)

Although the birth weight was marginally higher in the GDM group, the difference was not statistically significant. Meng et al.,2015 explained that effective glycemic control may limit macrosomia despite placental hypertrophy.(18)

Collectively, these results confirm that maternal diabetes induces both structural and functional alterations in the placenta through mechanisms involving endothelial dysfunction, oxidative stress, and altered angiogenic signaling.

Conclusion

The present study, in concordance with global evidence, demonstrates that GDM significantly influences placental morphology and morphometry. Increased placental weight, volume, and thickness in diabetic pregnancies indicate compensatory hypertrophy and hypervascularity. However, the reduced feto-placental ratio and morphological irregularities suggest compromised efficiency. Routine placental evaluation in GDM can thus provide valuable insights into fetal outcome prediction and maternal metabolic control.

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