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Original Research Article

Placental Ultrasound Changes in Normal Pregnancies and Gestational Diabetes Mellitus

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Abstract:

Background: The placenta undergoes significant physiological changes during pregnancy to accommodate the growing fetus. During a normal pregnancy, the placenta typically exhibits a gradual increase in echogenicity, or brightness, on ultrasound. In contrast, pregnancies complicated by gestational diabetes mellitus have been associated with distinct placental ultrasound changes. The present observational study has been conducted to determine the placental changes in pregnant women with GD.

Material and Methods: The study was conducted at Government Medical College, Jammu between January 2023 and December 2023. A total of 100 pregnant women were recruited for the study, with 50 women in the normal pregnancy group and 50 women in the Gestational Diabetes Mellitus group. Routine ultrasonographic examination was performed at 23- 24 and 33- 36 weeks gestation, which confirmed a normal pattern of foetal growth. All participants underwent routine prenatal care, including screening for Gestational Diabetes Mellitus using the oral glucose tolerance test. Placental ultrasound assessments were performed at three time points during pregnancy: 12-14 weeks, 20-22 weeks, and 32-34 weeks.

Results: There was no statistical difference in respect of age and initial BMI. Whereas, a statistically significant difference was observed among the participants in both groups in respect of Gestational Age, Weight gain, Fasting blood glucose, and glycated haemoglobin. In the GD group, 12% had irregularly shaped placenta. There was a significant difference between the two groups in respect of placental weight, diameter, central thickness, baby weight and fetal/ placental ratio.

Conclusion: The study concluded that there were distinct placental changes observed in Gestational Diabetes Mellitus compared to normal pregnancy. Specifically, the placenta in Gestational Diabetes Mellitus exhibited increased volume, elevated vascular resistance, and reduced placental function markers.

Keywords: Gestational Diabetes, Glycated Hemoglobin, Placental Changes.

Introduction

Pregnancy is a dynamic process that involves a series of coordinated physiological adaptations in the mother to support the growth and development of the fetus [1]. This includes changes in maternal metabolism, insulin sensitivity, and the production of placental hormones.

In a normal pregnancy, the mother's metabolism shifts from predominantly using carbohydrates to relying more on lipids as an energy source. This ensures that glucose is readily available for the growing fetus [2,3]. However, in some women, these physiological changes can lead to the development of gestational diabetes mellitus, a condition characterized by impaired glucose tolerance that manifests during pregnancy.

The placenta undergoes significant physiological changes during pregnancy to accommodate the growing fetus. During a normal pregnancy, the placenta typically exhibits a gradual increase in echogenicity, or brightness, on ultrasound. Additionally, the placental thickness may increase over time, reaching a maximum thickness in the late third trimester [3].

In contrast, pregnancies complicated by gestational diabetes mellitus have been associated with distinct placental ultrasound changes [1]. These include a more rapid increase in placental echogenicity and a greater placental thickness compared to normal pregnancies [3].

The changes observed in the placenta during gestational diabetes mellitus have significant

implications for both fetal and maternal health. Increased placental size and altered placental function can lead to an excess of nutrients and substrates reaching the fetus, contributing to fetal overgrowth and increased birth weight [4].

The placenta plays a critical role in mediating the maternal adaptations necessary to support pregnancy and fetal growth. Ultrasound imaging has become an invaluable tool in monitoring placental development and detecting changes associated with gestational diabetes mellitus [5].

Understanding the placental changes in normal and gestational diabetes pregnancies is crucial for improving the management and monitoring of these conditions, ultimately optimizing maternal and fetal health outcomes.

Accordingly, the present observational study has been conducted to determine the placental changes in pregnant women with GD.

Material and Methods

The present prospective observational study aimed to evaluate the changes in placental ultrasound parameters in normal and Gestational Diabetes Mellitus pregnancies. The study was conducted at Government Medical College, Jammu between January 2023 and December 2023, after clearance from the Institutional Ethical Committee.

A total of 100 pregnant women were recruited for the study, with 50 women in the normal pregnancy group and 50 women in the Gestational Diabetes Mellitus group. In both groups, deliveries occurred in term pregnancies (between 37 and 41 weeks of gestation).

Inclusion Criteria

1. Only the pregnant women of 18-40 years of attending the obstetrics and gynecology.
2. The subjects who were willing to participate in the study by signing an informed consent.
3. Patients who deliver in normal and Caesarean sections were included.

Exclusion Criteria

1. Patients who were less than 18 years and above 40,
2. Patients with blood-borne infections like HIV, Hepatitis, Patients with drug abuse, alcohol and smoking were excluded.

Routine ultrasonographic examination was performed at 23- 24 and 33- 36 weeks gestation, which confirmed a normal pattern of foetal growth. Gestational age was assessed by the last menstrual period or by a first-trimester ultrasound scan if there was a discrepancy of more than 1 week. GDM was diagnosed in the presence of a 100-g oral glucose tolerance test (OGTT) at 24-32 weeks. For GDM diagnosis, the American Diabetes Association (ADA) criteria-2000 was used.

All participants underwent routine prenatal care, including screening for Gestational Diabetes Mellitus using the oral glucose tolerance test.

Placental ultrasound assessments were performed at three time points during pregnancy: 12-14 weeks, 20-22 weeks, and 32-34 weeks. The following parameters were evaluated: Morphological changes concerning shape, weight, and diameter in the above disease conditions.

Statistical Analysis: Statistical analysis was performed using SPSS software version 22.0. Data expressed as mean, standard deviation, and percentages as applicable. Continuous variables were compared using the Student's t-test, and categorical variables were analyzed using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

In the present study, we included a total of 100 placentas out of which 50 placentas were of diabetic mothers and 50 placentas were of normal mothers. The anthropometrical and clinical features of the subjects included in the study are as follows:

Table 1: Anthropometric and clinical features

Characteristics	GD Group (N=50)	Normal Group (N=50)	p
Age (in years)	29.49 ± 5.73	28.08 ± 4.37	0.1696
Gestational Age (weeks)	26.51 ± 1.11	25.78 ± 1.09	0.0013*
Weight gain (kg)	13.15 ± 9.23	7.58 ± 5.19	0.0003*
Initial BMI (kg/m^2)	22.75 ± 4.14	22.37 ± 3.14	0.6062
Fasting Blood Glucose (mg/dl)	94.82 ± 28.62	83.18 ± 7.74	0.0066*
Glycated Haemoglobin (%)	6.81 ± 0.48	5.38 ± 0.31	<0.0001

Table 1 depicts the anthropometric and clinical features among both groups. It was observed that in both groups, no statistical difference was observed in respect of age and initial BMI. Whereas, a statistically significant difference was observed among the participants in both groups in respect of Gestational Age (P=0.0013), Weight gain (p=0.0003), Fasting blood glucose (0.0066), and glycated hemoglobin (p<0.0001).

Table 2: Placental shape distribution in both groups

		Group		Total
		GD Group (N=50)	Normal Group (N=50)	
SHAPE	Round count % within Group	24 48.0%	28 56.0%	52 52.0%
	Oval Count % within Group	20 40.0%	22 44.0%	42 42.0%
	Irregular Count % within Group	6 12.0%	0 0.0%	6 6.0%
Total count **% within Group**		50 100.0%	50 100.0%	100 100.0%

Table 2 depicts the placental shape distribution among the gestational diabetic and normal group. It was observed that in the normal group, 56.0% of subjects had round-shaped placenta whereas in the GD group, 48.0% of subjects had round-shaped placenta. Similarly, in the normal group, 44.0% had oval-shaped placenta whereas in the GD group, 40.0% had oval-shaped placenta. Further, in the GD group 12.0 % had irregularly shaped placenta whereas in the normal group, irregular placenta was not observed.

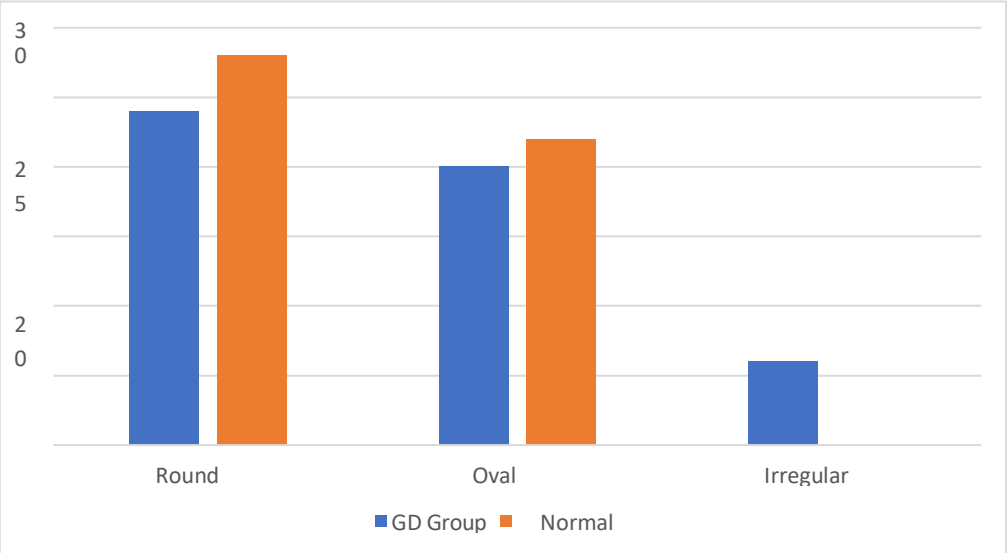

Figure 1: Placental Shape distribution

Table 3: Comparison of gross morphological parameters of diabetic placenta with reference to normal placenta

Characteristics	GD Group (Mean±SD)	Normal Group (Mean±SD)	p
Placental weight(gms)	570.15±86.68	479.63±86.49	<0.0001*
Diameter(cm)	18.25±1.29	17.52±1.19	0.0041*
Circumference(cm)	57.58±4.92	55.29±4.95	0.0224
Area(sq.cm)	257.78±46.56	245.13±43.83	0.1650
Central thickness(cm)	2.71±0.47	1.69±0.37	<0.0001*
Baby weight (Kg)	3.54±0.45	2.82±0.46	<0.0001*
Fetal/placental ratio	5.68±0.75	6.10±0.60	0.0026*

Table 3 depicts the comparison of gross morphological parameters of the diabetic placenta with reference to normal placenta.

It was observed that there was a significant difference between the weight of the placenta amongst the normal and diabetic groups. The mean weight of the placenta in the normal group was 479.63 gms whereas in the Gestational diabetic group, the mean weight was 570.15 gms ($p<0.0001$).

There was a significant difference between the diameter of the placenta among the GD and normal group ($p=0.0041$). The mean diameter in the normal group was 17.52 cm whereas in the GD group, the mean diameter was 18.25 cm.

There was no significant difference between the circumference of the placenta between the 2

groups. The mean circumference of the placenta in normal patients was 55.29cm while it was 57.58cm in the case of a diabetic patient (p=0.0224).

There was no significant difference between the areas of the placenta between the two groups. The mean area of the placenta in normal patients was 245.13sq.cm while in the case of diabetic patients, it was 257.78 sq. cm (p=0.1650).

There was a significant difference between the central thickness of the placenta between the two study groups. The mean placental thickness in a normal patient was 1.69cm while it was 2.71cm in the case of a diabetic patient (p<0.0001).

There was a significant difference in the birth weight of the baby between the two study groups. The mean birth weight of the baby in the normal patient was 2.82Kg while in the case of diabetic patients, it was 3.54Kg (p<0.0001).

There was a significant difference between the fetal/placental ratio between the two study groups. The mean fetal/placental ratio in normal patients was 6.10 while it was 5.68 in the case of diabetic patients (p=0.0026).

Discussion

The findings of this study highlight the distinct placental changes observed in Gestational Diabetes Mellitus compared to normal pregnancy. Consistent with previous research, the placenta in Gestational Diabetes Mellitus exhibited increased volume, elevated vascular resistance, and reduced placental function markers [6,7,8].

The placental hypertrophy observed in Gestational Diabetes Mellitus is likely a compensatory mechanism to enhance nutrient delivery to the growing fetus [6]. This compensatory placental growth, however, may not be sufficient to overcome the adverse effects of maternal hyperglycemia, insulin resistance, and other metabolic derangements associated with Gestational Diabetes Mellitus [6,7].

Elevated placental vascular resistance and reduced placental perfusion, as demonstrated by Doppler ultrasound, may contribute to the impaired nutrient and oxygen delivery to the fetus in Gestational Diabetes Mellitus. This can lead to adverse fetal outcomes, such as macrosomia, intrauterine growth restriction, and stillbirth.

It was observed that in both groups, no statistical difference was observed in respect of age and initial BMI. Whereas, a statistically significant difference was observed among the participants in both groups in respect of Gestational Age (P=0.0013), Weight gain (p=0.0003), Fasting blood glucose (0.0066), and glycated hemoglobin (p<0.0001). In a similar study by Escudero et al., 2013, structural changes and functional abnormalities in the placenta were observed in Gestational Diabetes Mellitus, which corroborates the findings of the present study [7].

It was observed that in the normal group, 56.0% of subjects had round-shaped placenta whereas in the GD group, 48.0% of subjects had round-shaped placenta. Similarly, in the normal group, 44.0% had oval-shaped placenta whereas in the GD group, 40.0% had oval-shaped placenta. Further, in the GD group 12.0 % had irregularly shaped placenta whereas in the normal group, irregular placenta was not observed. In a similar study by Zhuang et al., 2020, placental hypertrophy was found to be a common finding in gestational diabetes mellitus, which corroborates the findings of the present study [9]. In another similar study, altered placental Doppler parameters have been observed in gestational diabetes mellitus, which further supports the findings of the present study.

It was observed that there was a significant difference between the weight of the placenta amongst the normal and diabetic groups. The mean weight of the placenta in the normal group was 479.63 gms whereas in the Gestational diabetic group, the mean weight was 570.15 gms (p<0.0001). In similar studies by Kim et al., 2014 and Al-Sannan et al., 2019, increased placental weight has been reported in gestational diabetes mellitus compared to normal pregnancies, which is in line with the findings of the present study [10,11].

There was a significant difference between the diameter of the placenta among the GD and normal group (p=0.0041). The mean diameter in the normal group was 17.52 cm whereas in the GD group, the mean diameter was 18.25 cm. Similar studies by Aktar et al., 1970 and Taricco et al., 2003 have reported increased placental diameter in gestational diabetes mellitus, which corroborates the findings of the present study [12,13].

There was no significant difference between the circumference of the placenta between the 2 groups. The mean circumference of the placenta in normal patients was 55.29 cm while it was 57.58cm in the case of a diabetic patient (p=0.0224). There was no significant difference between the areas of the placenta between the two groups. The mean area of the placenta in normal patients was 245.13 sq cm while in the case of diabetic patients, it was 257.78 sq. cm (p=0.1650). There was a significant difference between the central thickness of the placenta between the two study groups. The mean placental thickness in a normal patient was 1.69cm while it was 2.71cm in the case of a diabetic patient (p<0.0001). There was a significant difference in the birth weight of the baby between the two study groups. The mean birth weight of the baby in the

normal patient was 2.82 Kg while in the case of diabetic patients, it was 3.54Kg ($p<0.0001$). There was a significant difference between the fetal/placental ratio between the two study groups. The mean fetal/placental ratio in normal patients was 6.10 while it was 5.68 in the case of diabetic patients ($p=0.0026$). The findings of our study with respect to placental weight, diameter, thickness, and fetal/placental ratio are in agreement with the earlier studies conducted by Aktar et al., 1970 and Taricco et al., 2003 [12,13].

Overall, the findings of this study suggest that Gestational Diabetes Mellitus leads to distinct placental structural and functional changes, including increased placental volume, elevated vascular resistance, and reduced placental perfusion. These placental alterations may contribute to the increased risk of adverse fetal outcomes associated with Gestational Diabetes Mellitus.

Conclusion

In summary, this study provides evidence of significant morphological and functional changes in the placenta of women with Gestational Diabetes Mellitus compared to normal pregnancies. Specifically, the placenta in Gestational Diabetes Mellitus exhibited increased volume, elevated vascular resistance, and reduced placental function markers. These placental alterations may contribute to the increased risk of adverse fetal outcomes associated with Gestational Diabetes Mellitus, highlighting the importance of close monitoring and management of the placenta in diabetic pregnancies.

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