

A morphological and histological study of placentae in diabetic gravid mothers

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Received: 28th June 2023; Accepted: 15th September 2023; Published: 01st January 2024

Abstract: *Background:* Observe the placental changes associated with Gestational Diabetes Mellitus and compare the same with normal pregnancy. Factors controlling these changes have been widely studied in past aiding the fundamental approach of current study. *Objectives:* The study aims at determining the morphological and morphometric changes in placenta of gravid mothers having Diabetes Mellitus as well as comparing the placental histology between diabetic and non-diabetic pregnant mothers. *Methods and Material:* 60 placentae were collected (30 cases and 30 controls) from Diabetic and non-diabetic gravid mothers. Various morphological and histological parameters were studied as per study design and pre-set objectives. Statistical analysis was done for central tendency. *Results:* The weight, volume and thickness of placentae among Diabetic mothers were significantly more than that of normal mothers. Syncytial knots, villous edema, cytotrophoblast proliferation, fibrinoid degeneration, calcification and other histological study parameters showed significant variations between the study and control group. *Conclusions:* Changes in placentae of gravid diabetic mothers were consistent with previous studies barring a few contradictory results as well. Existence of other comorbidities along with Diabetes Mellitus in pregnancy might add up to further changes which can be investigated in future ventures.

Keywords: Syncytial Knots, Fibrinoid Degeneration, Gestational Diabetes

Introduction

The Placenta [1] is an ephemeral organ interposed between the gravid mother and the developing fetus. The biological status of the placenta is closely indicative of the fetal growth. The word Placenta was first coined by Realdus Columbus in the year 1559 and the word Placenta is derived from the word *Plakos* meaning cake or from the Greek word *Plakoenta*. *Diabetes mellitus* of the gravid mother, both pre-existing or gestational results in some changes in the placenta which distinctly affect the growth of the fetus influencing the mortality and morbidity of the fetus.

It has been observed that in many cases the Diabetes Mellitus and Hypertension co-exist in case of gravid mothers. Therefore, the observations, particularly in respect of

histological changes may be the manifestations of these joint health hazards. The changes in the placenta of the diabetic mother are influenced by the level of blood sugar and the tenure of duration of the diabetes mellitus. In diabetes mellitus the placenta may be of larger size, it may have a pale appearance which is due to villous edema and some histological changes like that of pregnancy induced hypertension such as hyalinization and calcium deposition in the villi are seen. Such changes may involve the alteration in the capillary basement membrane resulting in moderate thickening of the same including distortion of syncytium. The present study aims at determining the histomorphometric variations of placenta among diabetic gravid mothers with respect to normal pregnant mothers.

Material and Methods

Altogether 60 Placentae (singleton pregnancy) were collected from the Department of Obstetrics & Gynecology of Medical College in Orisa, for a period of 6 months, out of which 30 placentae from non-diabetic mothers (control group) and 30 placentae from diabetic (both pre-existing and gestational) mothers (study group). Some variations as regards the changes of the placenta of the diabetic mother is natural. This is because the insult inflicted to the placenta in diabetic mother is perhaps associated with the level of blood sugar. In this study, mothers having fasting blood sugar level more than 110 mg/dl and post prandial blood sugar level more than 140 mg/dl were selected, following the ADA (American Diabetic Association) classification for Diabetes Mellitus.

Each placenta under study were collected immediately after delivery in a clean tray. Then washed in running tap water and dried by blotting paper. Blood clots were removed and depressed area were noted. Membranes were trimmed off and following were studied in respect of each placenta:

- a) Weight
- b) Volume
- c) Diameter
- d) Thickness
- e) Attachment of umbilical cord (centric, eccentric, marginal, or velamentous).
- f) Examination of maternal surface
- g) Foeto-Placental ratio.
- h) Histological study

Antenatal history of the concerned mothers was collected from the records of the Hospital to categorise the non-diabetic and diabetic mothers. Emphasis was laid on the following points:

- a) Age and general health
- b) Parity
- c) L.M.P
- d) Blood pressure (Whether hypertensive or not)

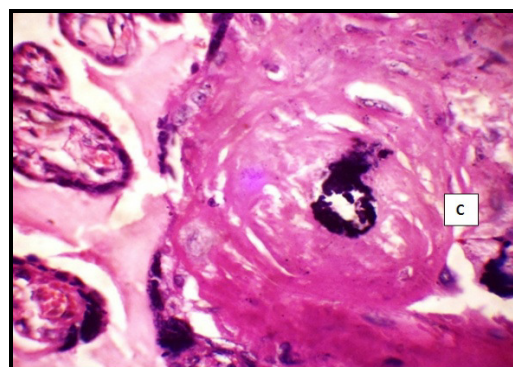
- e) Level of FBS and PPBS as recorded.
- f) Previous obstetrical history for notable significance if any.

The data were recorded and statistical analysis was performed for measures of central tendency. The statistical significance (p value) was calculated using the t-test or Chi Square test (as applicable). All results were subsequently compared with similar past studies and records as per study requirements.

Results

Macroscopic examination revealed, areas of calcification (as shown in Figure 1) and infarction are more in the study group as compared to the control group.

Fig-1: Photomicrograph of placenta in a gravid Diabetic mother showing area of Calcification (C) on histological examination



Histological study reveals an increase in number of syncytial knot (25%) and decrease in the concentration of villi in the study group. Histologically, it was also found that number of calcified areas (30%) are greater in study group compared to control group. The other notable features identified in the placentae of diabetic mothers were - villous oedema, villous immaturity, fibrinoid necrosis (50%) and stromal fibrosis (25%). The comparison of gross features between the study and control groups are shown in Table 1 & 2.

Table-1: Showing the placental morphometry between the two groups (Control & Diabetic)				
Parameter	Control group	Study group (Diabetic mother)	P Value	Comment
Weight in Gm (Mean.)	575.09 ± 67.09	646.80 ± 86.26	<0.05	Significant.
Volume in cc (Mean)	551.15 ± 82.82	590.80 ± 93.41	<0.05	Significant.
Thickness at the centre in cm. (Mean)	2.39 ± 0.18	2.23 ± 0.15	<0.001	Significant.
Diameter in cm. (Mean)	20.41 ± 2.70	20.77 ± 2.74	>0.05	Insignificant.

Table-2: Showing the Placental morphology between the two groups of placentae (Control & Diabetic)

Parameters	Control group	Study group (Diabetic mothers)	P Value	Comment
Number of cotyledons (Mean)	18.05±1.75	18.35±1.63	0.38	Insignificant
Placental surface area in cm ²	265.87±24.16	267.79±53.09	0.92	Insignificant
Number of calcified area (Mean)	3.56±0.96	16.83±1.86	<0.001	Significant

Discussion

The findings of present study with respect to the gross morphometric assessment like weight, volume and surface area were consistent with that of previous works [2-7]. It was observed that the placental weight and neonatal weight were increased, provided the diabetes was not complicated with vascular disease, as reported by Maksheed et al [8]. Present study showed that the attachment of umbilical cord in diabetic placentae is mostly eccentric (as shown in Figure 2). Similar observation was given by Majumdar S. et al [9].

Fig-2: Eccentric attachment of umbilical cord in placenta of a gravid Diabetic mother



In the present study, it has been observed that diameters of diabetic placentae were usually higher than that of normal placentae but that was not statistically significant (P value =0.618) being consistent with similar findings by previous authors as well [9]. Regarding thickness, it was observed that the thickness at the centre in placentae of study group was slightly higher than that of control group which was not significant statistically having P value 0.12. Similar findings were reported by Majumder S et al [9].

There were slightly higher or same number of cotyledons on maternal surface of the placentae

(study & control groups) in our present study as also seen in previous references [9]. Mean infant birth weight was found to be slightly increased in this group. Comparable observations were made by Desoye G et al[6], Persson and Hanson [10] and Majumder S. et al [9] but contradictory opinion was also available from the study results of Gillman et al [11], who reported that birth weight of babies born to GDM mothers were not significantly different than control. Sub chorionic fibrosis was found to be less than that of control group which corroborates with the study results of H. Fox [12-13], Majumder S. et al[9] and Vineeta Tiwari [7]. H. Fox [12-13] found calcification in less number of placentae of diabetic mothers, while in present study calcification was found in 40-45% cases.

The same observation was given by Ana Karina Marques Salge et al [14]. In the present study about 40% placentae from diabetic mothers were found with the normal villous pattern for the length of gestational period which is similar with the study result of Fox [12]. Rest 60% cases showed moderately change in the villous tree with the tenure of pregnancy, some appeared unduly immature and others showed apparently accelerated maturation which is corroborative with the study done by Majumdar S. et. al [9].

In this study it has been observed that in the placentae of study group villous oedema was very common with the varying villous vascularity. Some villi were found to be hypo-vascular and others were hyper-vascular (sign of diabetic micro-angiopathy). Similar findings were reported by previously [15]. There was also evidence of increased cytotrophoblastic cellular proliferation, mild to moderate thickening of basement membrane with capillaries in hypo-vascular

villi, stromal fibrosis and syncytial knot formation. The study group also showed increase number of 'Hofbauer cells', increased fibrinoid necrosis of villi, increased hyalinization and calcification of villi consistent with previous works also [15-22].

In some cases, it has been found that the mother having diabetes mellitus during pregnancy was complicated by hypertension (essential or P.I.H.). There had been text references that the pregnancy induced hypertension raises many folds in presence of diabetes than the uncomplicated pregnancy. In such co-existence of diseases all the parameters were found to be more prominent than the placenta of mothers having only diabetes or hypertension.

Conclusion

The interplay of genetics, dietetics and fetoplacental hemodynamics on the morphology and micro-anatomy of developing placenta as well as the fetal well-being is intriguing for both GDM

and normal pregnancy. There has been previous evidence of role of placental gender affecting its histology and morphology in Diabetic pregnant mothers [23], but the recent study could not cultivate the correlation. Similarly, the combined effect of Pregnancy Induced Hypertension (PIH) and GDM, let alone the impact of either of the co-morbidities individually, might alter the course of pregnancy and fetoplacental morphology might be altered in varied ways as documented in previous studies [24].

The scope of present study can be extended in future to assess the effect of Gestational Diabetes Mellitus, Pregnancy Induced Hypertension and other co-morbidities on placenta and fetal growth and maturity. Animal models might be helpful to detect any genetic link between such pathophysiological changes for better understanding of the correlations.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

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Cite this article as: Choudhury S, Rakshit A, Paul T and Poddar R. A morphological and histological study of placenta in diabetic gravid mothers. *Al Ameen J Med Sci* 2024; 17(1):6-10.

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