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Gross Morphological Changes in Placenta of Women with Gestational Diabetes Mellitus and Pregnancy-Induced Hypertension Compared to Normal Pregnancies: A Review

Farzana Jailani manchankop[1], Dr. Ravindra Vedpathak[2], Dr. Nishigandha Sadamate[3], Dr. Rakesh Kumar Jha[4], Dr. Shyambabu Prasad Rauniyar[5]

[1]PhD Scholar, Department of Anatomy, Jawaharlal Nehru Medical College, Datta Meghe institute of Higher Education and Research, Sawangi (M), Wardha, Email: farzana.farajm@gmail.com
[2]Associate professor, Department of Anatomy, Jawaharlal Nehru Medical College, Datta Meghe institute of Higher Education and Research, Sawangi (M), Wardha, Email: vedbhagy@gmail.com
[3]Associate professor, Department of Anatomy, Jawaharlal Nehru Medical College, Datta Meghe institute of Higher Education and Research, Sawangi (M), Wardha, Email: sadamatenishi@gmail.com
[4]Assistant professor, Department of Biochemistry, Jawaharlal Nehru Medical College, Datta Meghe institute of Higher Education and Research, Sawangi (M), Wardha, Email: jhaarakesh1993@gmail.com
[5]Assistant professor, Department of Anatomy, Datta Meghe Medical College, Wanadongri, Datta Meghe institute of Higher Education and Research, Sawangi (M), Wardha, Email: shyambaburauniyar@gmail.com

ABSTRACT

Background: The placenta is the blood vessel that connects the mother and fetus and the gross morphology of the placenta indicates the effects of maternal diseases like Gestational Diabetes Mellitus (GDM) and Pregnancy-Induced Hypertension (PIH). Placental weight, size, thickness, infarctions, calcification, and cord insertion abnormalities can impair the materno-fetal exchange, which plays a role in the poor perinatal outcomes.

Material and Methods: The systematic search involved PubMed, Scopus, Embase, and Cochrane Library and involved search using the following keywords: placenta, gestational diabetes mellitus, pregnancy-induced hypertension, gross morphology, infarction, calcification, and cord insertion up to 2024. Articles presenting gross morphological data in placentas in GDM, PIH and normal pregnancies were included and those with case reports, incomplete abstracts and articles with no morphological information were excluded. Significant parameters obtained were; placental weight, dimensions, thickness, presence of infarcts, calcification and cord of insertion type.

Conclusion: The use of gross morphological assessment of the placenta gives helpful information on the impact of maternal metabolic and vascular disorders. Observable variations in GDM and PIH indicate the adaptive and pathological reactions of the placenta, which is why the systematic postnatal examination is necessary as a complementary diagnostic tool.

KEYWORDS: Placenta, Gestational Diabetes Mellitus, Pregnancy-Induced Hypertension, Morphology, Infarcts, Calcification

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INTRODUCTION

The placenta is a very specialized organ that acts as a point of contact between the mother and fetus thus facilitating transfer of nutrients, gas exchange and support of hormones. Gross morphological alterations of the placenta give a direct indication of intrauterine factors and maternal systemic disorders (1). During normal pregnancies, the placentas are discoid, weighing about 470-500 grams, the mean diameter being 15-20 cm, the central cord insertion is 2-3 cm in thickness and is discoid in shape (2). Gestational Diabetes Mellitus (GDM), which is defined by the presence of glucose intolerance onset in pregnancy, has been demonstrated to affect placental weight and size. Hyperglycemia promotes trophoblastic growth, angiogenesis and in remodelling villi leading to heavier placentas that are thicker and marginal cord insertion (3,4). All these adaptations are compensatory strategies in order to support the higher metabolic requirements of the fetus in hyperglycemic environment (5). Conversely, Pregnancy-Induced Hypertension (PIH), which encompasses gestational hypertension and preeclampsia is linked to poor uteroplacental blood flow and ischemic damage. PIH placentas are smaller and thinner, have lower weights and often have infarctions, calcification, and retroplacental hematoma (6,7). Deviations in cord insertion including the velamentous and eccentric insertion are also more common in PIH than normal pregnancies (8). Gross placental evaluation comparing GDM and PIH demonstrates the difference in pathogenesis of the two conditions: hyperplastic and hypertrophic in GDM and ischemic and degenerative in PIH. These differences are not theoretical only, but have significant clinical implications. Macrosomia and neonatal hypoglycemia are typical in GDM and intrauterine growth restriction (IUGR), low birth weight, and preterm deliveries are typical in PIH (9,10). This review is a synthesis of evidence concerning the gross morphological changes between placentas of GDM and PIH pregnancies, and normal pregnancies. The parameters to be taken into consideration are placenta weight, size,

thickness, infarcts and calcification prevalence and cord insertion patterns. The knowledge of these changes can enhance the awareness of pathological processes in high-risk pregnancies and postnatal assessment as the tool of maternal and fetal complication prediction (11).

MATERIAL AND METHODS

Extensive literature review was done in order to compare the gross morphological placental changes in Gestational Diabetes Mellitus (GDM), Pregnancy-Induced Hypertension (PIH) with normal pregnancies. PubMed, Scopus, Embase and Cochrane Library, which are electronic databases, were searched systematically until 2024. Search terms were placenta, gestational diabetes mellitus, pregnancy-induced hypertension, gross morphology, placental weight, infarction, calcification and cord insertion.

The inclusion criteria included original research articles, reviews and meta-analysis that reported the gross placental morphology-weight, size, thickness, infarcts, calcification and cord insertion. Case reports, conference abstracts and studies which only involved biochemical or molecular results and did not entail gross morphological examination were excluded. Data extracted from eligible studies included placental dimensions, weight, thickness, incidence of infarcts and calcification, and cord insertion types. Findings were synthesized narratively to highlight differences between GDM, PIH, and normal pregnancies. Emphasis was placed on reproducible observations with clinical relevance to maternal and fetal outcomes.

DISCUSSION

Gross morphological examination of the placenta provides crucial insight into the impact of maternal metabolic and vascular conditions. In GDM, studies consistently report increased placental weight, often exceeding 600 grams, along with larger diameters and greater thickness (12). These findings are attributed to hyperglycemia-driven villous hypertrophy and enhanced vascularization. Madazlı et al. reported heavier placentas in GDM cases compared to controls, correlating with fetal macrosomia (13). Similarly, Ashfaq et al. observed that GDM placentas exhibited marginal and velamentous cord insertions more frequently, possibly reflecting altered trophoblastic growth (14).

By contrast, PIH placentas are typically lighter and smaller, with reduced dimensions and thickness. Rani et al. demonstrated that PIH placentas averaged 350–400 grams, significantly less than controls (15). Macroscopic findings include multiple infarcts, firm consistency, and extensive calcification. Infarction arises from maternal vascular malperfusion, whereas calcification reflects premature aging of the placenta (6,7). Such ischemic alterations are associated with such clinical outcomes as intrauterine growth restriction and low birth weight (9).

When compared to normal pregnancies, there are obvious differences. Normal placentas usually have the central cord insertion and even thickness without serious degenerative lesions (2). Compensatory hyperplasia aids with macrosomic growth in GDM and constrained placenta with ischemia hinders growth in PIH (10). Hence, the two conditions have significant differences in their pathophysiological processes and clinical implications although they share similar changes in placental morphology.

The frequency of abnormal cord insertions is higher in both GDM and PIH in comparison to normal pregnancies. Velamentous cord insertion has been associated with poor perinatal outcomes such as fetal distress and stillbirth (8) at PIH. Marginal cord insertion might be an indicator of dysregulated trophoblastic invasion in GDM due to hyperglycemia (5,14).

Taken together, the case of gross morphological alterations in the placentas of both GDM and PIH offers pathological history of the interactions between the mother and fetus. It is not only that their recognition is important in postnatal diagnosis, but could be used predictively too. Strategic incorporation of systematic placental examination into clinical practice can contribute to identifying at-risk neonates and give retrospective confirmation of maternal disease processes (16).

CONCLUSION

Placental gross morphology varies greatly between normal pregnancies, GDM, and PIH. The placentas of GDM tend to be larger, heavier and thicker with marginal cord insertions a result of compensatory hypertrophy. PIH placentas, in contrast, are smaller and thinner in nature, with numerous infarcts, calcifications and common abnormal cord attachments, which is ischemic and degenerative pathology. These morphological differences highlight the dual nature of the placenta as an adaptive and susceptible organ in maternal pathology. A comparative analysis of placenta results can be one of the effective diagnostic complements, which contribute to our knowledge of pregnancy complications and better ways of managing the mother-fetus care.

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