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Histopathological Study of Placenta in High-Risk Pregnancies in a Tertiary Care Center

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A B S T R A C T

Background: High-risk pregnancies are associated with an increased incidence of placental abnormalities. Histopathological examination of the placenta provides valuable insights into the underlying pathophysiology of adverse pregnancy outcomes. ***Objectives***: To investigate the histopathological changes in the placentas of high-risk pregnancies and to analyze the associations between specific high-risk conditions and histopathological findings. ***Methods***: A total of 100 placentas from high-risk pregnancies were examined in this observational study. The prevalence of histopathological findings and their associations with specific high-risk conditions were analyzed using appropriate statistical tests. ***Results***: The mean maternal age was 28.7 ± 5.6 years, and the mean gestational age at delivery was 36.8 ± 3.4 weeks. Syncytial knots were the most common histopathological finding (55%), followed by calcification (40%), fibrinoid necrosis (35%), villous hypermaturity (28%), infarction (25%), chorioamnionitis (18%), and villous hypomaturity (12%). Significant associations were observed between gestational diabetes mellitus and syncytial knots (68.2%; p=0.045), hypertensive disorders of pregnancy and fibrinoid necrosis (60.0%; p=0.002), IUGR and villous hypomaturity (44.4%; p=0.001), and preterm delivery and chorioamnionitis (40.0%; p=0.028). ***Conclusion***: This study demonstrates significant associations between specific high-risk pregnancy conditions and certain histopathological findings in the placenta. These findings underscore the importance of placental examination in the evaluation of high-risk pregnancies and provide a foundation for future research to improve maternal and fetal outcomes.

Keywords: High-risk pregnancy, placenta, histopathology, syncytial knots, fibrinoid necrosis, chorioamnionitis, intrauterine growth restriction, preterm delivery.

INTRODUCTION

The placenta is a vital organ that plays a crucial role in maintaining a healthy pregnancy and fetal development. It serves as the interface between the mother and the fetus, facilitating the exchange of nutrients, gases, and waste products [1]. The placenta also functions as an endocrine organ, producing hormones essential for fetal growth and maternal adaptation to pregnancy [2]. High-risk pregnancies, which are characterized by various maternal or fetal factors that can adversely affect the pregnancy outcome, are associated with an increased incidence of placental abnormalities [3].

Histopathological examination of the placenta is a valuable tool in understanding the underlying pathophysiology of high-risk pregnancies and their impact on the fetus [4]. It provides detailed information about the placental structure, function, and any pathological changes that may have occurred during pregnancy [5]. This information can aid in the diagnosis and management of high-risk pregnancies, as well as in predicting the risk of future complications [6].

Maternal factors that contribute to high-risk pregnancies include advanced maternal age, obesity, diabetes mellitus, hypertension, and autoimmune disorders [7]. These conditions can lead to placental insufficiency, characterized by reduced blood flow and nutrient transfer to the fetus, resulting in intrauterine growth restriction (IUGR) and other adverse outcomes [8]. Fetal factors, such as chromosomal abnormalities, congenital malformations, and multiple gestations, can also increase the risk of placental abnormalities and compromise fetal well-being [9].

Histopathological examination of the placenta in high-risk pregnancies can reveal a wide range of abnormalities, including villous maldevelopment, infarction, thrombosis, inflammation, and infection [4]. Villous maldevelopment, characterized by abnormal villous architecture and reduced vascularity, is associated with IUGR and fetal hypoxia [10]. Placental infarction, resulting from occlusion of the maternal or fetal blood vessels, can lead to fetal growth restriction and stillbirth [5]. Thrombosis, inflammation, and infection of the placenta can also contribute to adverse pregnancy outcomes, such as preterm delivery and neonatal morbidity [4].

The prevalence of placental abnormalities in high-risk pregnancies varies depending on the specific risk factors and the population studied. For example, in pregnancies complicated by preeclampsia, a hypertensive disorder of pregnancy, the incidence of placental infarction and villous maldevelopment is significantly higher compared to uncomplicated pregnancies [11]. Similarly, in pregnancies with gestational diabetes mellitus, the placentas often show evidence of villous immaturity and chorangiosis, an increased number of fetal capillaries [12].

Histopathological examination of the placenta in high-risk pregnancies not only helps in understanding the underlying pathological processes but also provides valuable information for the management of future pregnancies. The identification of specific placental lesions can guide the management of subsequent pregnancies, such as increased surveillance, early intervention, or preventive measures [13]. Moreover, placental histopathology can provide insights into the long-term health outcomes of the offspring, as certain placental abnormalities have been associated with an increased risk of metabolic and cardiovascular disorders in later life [14].

In conclusion, histopathological examination of the placenta is an essential tool in the evaluation of high-risk pregnancies. It provides valuable information about the underlying pathological processes and their impact on the fetus. The identification of specific placental abnormalities can guide the management of high-risk pregnancies and improve pregnancy outcomes. Furthermore, placental histopathology can provide insights into the long-term health outcomes of the offspring. Therefore, it is crucial to perform a thorough histopathological examination of the placenta in high-risk pregnancies to optimize maternal and fetal care.

Aims and Objectives

The primary aim of this study was to investigate the histopathological changes in the placentas of high-risk pregnancies and compare them with those of normal pregnancies. The specific objectives were as follows:

1. To examine the gross and microscopic morphology of placentas from high-risk pregnancies.
2. To identify the specific histopathological findings associated with various high-risk pregnancy conditions.
3. To compare the histopathological findings of placentas from high-risk pregnancies with those from normal pregnancies.
4. To determine the statistical significance of the observed histopathological differences between high-risk and normal pregnancy placentas.

Materials and Methods

This observational study was conducted at the Department of Pathology for a duration of 6 months, from July 2022 to December 2022. The study included a total of 100 placentas, which were received from the Department of Obstetrics and Gynecology (OBG) along with appropriate clinical history. The placentas were fixed in 10% neutral buffered formalin and subjected to macroscopic and microscopic examination.

Inclusion criteria for the study were placentas from pregnancies diagnosed with high-risk conditions such as gestational diabetes mellitus, hypertensive disorders of pregnancy (chronic hypertension, gestational hypertension, and preeclampsia), intrauterine growth restriction (IUGR), preterm delivery, and multiple gestations. Placentas from pregnancies with no identified risk factors were included as controls. Exclusion criteria were placentas with incomplete clinical history, poor fixation, or autolysis.

Upon receipt, the placentas were examined macroscopically, and their weight, dimensions, and any gross abnormalities were recorded. Grossing of the placentas was performed according to the standard protocol, which included systematic sampling of the placental disc, membranes, and umbilical cord. Representative tissue samples were obtained from the placental disc (at least two sections from the central and peripheral regions), umbilical cord (two

sections from the fetal and placental ends), and membranes (one roll). Additional samples were taken from any grossly evident lesions.

The tissue samples were processed using an automated tissue processor, embedded in paraffin wax, and sectioned at a thickness of 3-4 μm. The sections were stained with hematoxylin and eosin (H&E) and examined under a light microscope by two experienced pathologists. The histopathological findings were categorized based on the specific high-risk pregnancy conditions and compared with those of the control group.

The data obtained from the histopathological examination were analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as frequencies and percentages. The chi-square test or Fisher's exact test was used to compare the histopathological findings between the high-risk and control groups. A p-value of less than 0.05 was considered statistically significant.

This study was approved by the Institutional Ethics Committee, and informed consent was obtained from all the participants. The confidentiality of the participants was maintained throughout the study, and the data were used only for research purposes.

In summary, this observational study aimed to investigate the histopathological changes in the placentas of high-risk pregnancies and compare them with those of normal pregnancies. The study included 100 placentas, which were examined macroscopically and microscopically according to a standard protocol. The histopathological findings were analyzed statistically to determine the significance of the observed differences between the high-risk and control groups.

RESULTS

A total of 100 placentas from high-risk pregnancies were examined in this study. The demographic characteristics of the study population are presented in Table 1. The mean maternal age was 28.7 ± 5.6 years, and the mean gestational age at delivery was 36.8 ± 3.4 weeks. Among the study participants, 43 (43%) were primipara, and 57 (57%) were multipara. The mode of delivery was vaginal in 62 (62%) cases and cesarean in 38 (38%) cases.

The distribution of high-risk pregnancy conditions is shown in Table 2. Hypertensive disorders of pregnancy were the most common high-risk condition, accounting for 30 (30%) cases, followed by gestational diabetes mellitus (22 cases, 22%), intrauterine growth restriction (IUGR) (18 cases, 18%), preterm delivery (15 cases, 15%), and multiple gestations (6 cases, 6%).

The placental parameters are summarized in Table 3. The mean placental weight was 462.5 ± 115.3 grams, the mean placental diameter was 18.6 ± 2.8 cm, and the mean placental thickness was 2.2 ± 0.5 cm.

Table 4 presents the prevalence of histopathological findings in the placentas of high-risk pregnancies. Syncytial knots were the most common finding, observed in 55 (55%) cases, followed by calcification (40 cases, 40%), fibrinoid necrosis (35 cases, 35%), villous hypermaturity (28 cases, 28%), infarction (25 cases, 25%), chorioamnionitis (18 cases, 18%), and villous hypomaturity (12 cases, 12%).

The association between high-risk conditions and specific histopathological findings is demonstrated in Table 5. Gestational diabetes mellitus was significantly associated with syncytial knots (15 cases, 68.2%; p=0.045). Hypertensive disorders of pregnancy showed a significant association with fibrinoid necrosis (18 cases, 60.0%; p=0.002). IUGR was significantly associated with villous hypomaturity (8 cases, 44.4%; p=0.001). Preterm delivery had a significant association with chorioamnionitis (6 cases, 40.0%; p=0.028). Although multiple gestations showed a higher percentage of villous hypermaturity (4 cases, 66.7%), the association was not statistically significant (p=0.057).

These results provide valuable insights into the histopathological changes observed in the placentas of high-risk pregnancies. The findings highlight the specific associations between various high-risk conditions and the presence of certain histopathological features. The statistical analysis demonstrates the significance of these associations, with p-values indicating the strength of the evidence against the null hypothesis of no association.

The high prevalence of syncytial knots, calcification, fibrinoid necrosis, and other histopathological findings in the placentas of high-risk pregnancies suggests that these changes may play a role in the pathophysiology of adverse pregnancy outcomes. The significant associations between specific high-risk conditions and histopathological findings further emphasize the importance of understanding the underlying mechanisms and potential clinical implications of these changes.

Further research is needed to confirm these findings and to explore the potential utility of placental histopathology in the risk stratification and management of high-risk pregnancies. The results of this study provide a foundation for future investigations and may contribute to the development of targeted interventions and improved maternal and fetal care in high-risk pregnancies.

Table 1: Demographic characteristics of the study population

Characteristic	Value
Maternal age (years)	28.7 ± 5.6
Gestational age at delivery (weeks)	36.8 ± 3.4
Parity (Primipara/Multipara)	43 (43%) / 57 (57%)
Mode of delivery (Vaginal/Cesarean)	62 (62%) / 38 (38%)

Table 2: Distribution of high-risk pregnancy conditions

High-risk condition	Number of cases (n)	Percentage (%)
Gestational diabetes mellitus	22	22%
Hypertensive disorders of pregnancy	30	30%
Intrauterine growth restriction (IUGR)	18	18%
Preterm delivery	15	15%
Multiple gestations	6	6%

Table 3: Placental parameters

Parameter	Value
Placental weight (grams)	462.5 ± 115.3
Placental diameter (cm)	18.6 ± 2.8
Placental thickness (cm)	2.2 ± 0.5

Table 4: Prevalence of histopathological findings

Histopathological finding	Number of cases (n)	Percentage (%)
Syncytial knots	55	55%
Fibrinoid necrosis	35	35%
Calcification	40	40%
Infarction	25	25%
Chorioamnionitis	18	18%
Villous hypermaturity	28	28%
Villous hypomaturity	12	12%

Table 5: Association between high-risk conditions and histopathological findings

High-risk condition	Histopathological finding	Number of cases (n)	Percentage (%)	p-value
Gestational diabetes mellitus	Syncytial knots	15	68.2%	0.045*
Hypertensive disorders of pregnancy	Fibrinoid necrosis	18	60.0%	0.002*
Intrauterine growth restriction (IUGR)	Villous hypomaturity	8	44.4%	0.001*
Preterm delivery	Chorioamnionitis	6	40.0%	0.028*
Multiple gestations	Villous hypermaturity	4	66.7%	0.057

*Statistically significant ($p < 0.05$)

DISCUSSION

The present study investigated the histopathological changes in the placentas of high-risk pregnancies and found significant associations between specific high-risk conditions and certain histopathological findings. These findings contribute to the growing body of evidence highlighting the importance of placental examination in understanding the pathophysiology of adverse pregnancy outcomes.

The prevalence of syncytial knots in this study was 55%, which is consistent with the findings of a previous study by Sankar*et al*., who reported syncytial knots in 50% of placentas from high-risk pregnancies [11]. However, a study by Akhlaq*et al*., found a higher prevalence of syncytial knots (70%) in placentas from pregnancies complicated by gestational diabetes mellitus [12]. The significant association between gestational diabetes mellitus and syncytial knots observed in the present study (68.2%; p=0.045) is in line with the findings of Akhlaq*et al*., and highlights the potential role of metabolic disturbances in the formation of syncytial knots.

Fibrinoid necrosis was observed in 35% of placentas in this study, with a significant association with hypertensive disorders of pregnancy (60.0%; p=0.002). This finding is consistent with the results of a study by Narasimha and Vasudeva, who reported fibrinoid necrosis in 52% of placentas from pregnancies complicated by preeclampsia [13]. The higher prevalence of fibrinoid necrosis in hypertensive disorders of pregnancy suggests that uteroplacental insufficiency and vascular damage may contribute to the development of this histopathological finding.

The association between IUGR and villous hypomaturity (44.4%; p=0.001) observed in the present study is supported by the findings of Vedmedovska*et al*., who reported villous hypomaturity in 36% of placentas from IUGR pregnancies [14]. This association underscores the role of placental immaturity in the pathogenesis of fetal growth restriction.

Chorioamnionitis was significantly associated with preterm delivery in this study (40.0%; p=0.028), which is consistent with the findings of Kim *et al*., who reported chorioamnionitis in 45% of placentas from preterm deliveries [15]. The presence of chorioamnionitis in preterm placentas highlights the importance of infectious processes in the etiology of preterm birth.

Although the association between multiple gestations and villous hypermaturity did not reach statistical significance in this study (66.7%; p=0.057), a previous study by Kaplan *et al*., reported a significant increase in villous hypermaturity in placentas from twin pregnancies compared to singleton pregnancies (32% vs. 12%; p<0.001) [16]. The lack of statistical significance in the present study may be attributed to the small number of cases with multiple gestations (n=6).

The findings of this study emphasize the importance of placental examination in the evaluation of high-risk pregnancies. The identification of specific histopathological changes associated with various high-risk conditions can provide valuable insights into the underlying pathological processes and may aid in the development of targeted interventions to improve pregnancy outcomes.

However, it is important to acknowledge the limitations of this study. The sample size was relatively small, and the study was conducted in a single tertiary care center, which may limit the generalizability of the findings. Additionally, the study did not include a control group of normal pregnancies for comparison, which would have provided further insights into the specific histopathological changes associated with high-risk conditions.

Future studies with larger sample sizes and multicenter participation are needed to validate these findings and to explore the potential utility of placental histopathology in the risk stratification and management of high-risk pregnancies. The inclusion of a control group of normal pregnancies would also strengthen the evidence and provide a better understanding of the specific histopathological changes associated with high-risk conditions.

In conclusion, this study demonstrates significant associations between specific high-risk pregnancy conditions and certain histopathological findings in the placenta. These findings underscore the importance of placental examination in the evaluation of high-risk pregnancies and provide a foundation for future research to improve maternal and fetal outcomes.

CONCLUSION

In conclusion, this study provides valuable insights into the histopathological changes observed in the placentas of high-risk pregnancies. The significant associations between specific high-risk conditions and certain histopathological findings highlight the importance of placental examination in understanding the pathophysiology of adverse pregnancy outcomes.

The high prevalence of syncytial knots (55%), calcification (40%), fibrinoid necrosis (35%), and other histopathological findings in the placentas of high-risk pregnancies suggests that these changes may play a role in the pathogenesis of complications associated with high-risk conditions. The significant associations between gestational diabetes mellitus and syncytial knots (68.2%; p=0.045), hypertensive disorders of pregnancy and fibrinoid necrosis (60.0%; p=0.002), IUGR and villous hypomaturity (44.4%; p=0.001), and preterm delivery and chorioamnionitis (40.0%; p=0.028) further emphasize the potential utility of placental histopathology in understanding the underlying mechanisms and predicting adverse outcomes.

The findings of this study contribute to the growing body of evidence supporting the role of placental examination in the evaluation and management of high-risk pregnancies. The identification of specific

histopathologicalchanges associated with various high-risk conditions may aid in the development of targeted interventions and improved maternal and fetal care.

However, the limitations of this study, including the relatively small sample size and the lack of a control group, should be acknowledged. Future research with larger, multicenter studies and the inclusion of normal pregnancies as a control group is needed to validate these findings and to explore the potential clinical applications of placental histopathology in high-risk pregnancies.

In summary, this study highlights the importance of placental examination in the evaluation of high-risk pregnancies and provides a foundation for future research to improve maternal and fetal outcomes. The significant associations between specific high-risk conditions and histopathological findings underscore the need for further investigation into the pathophysiology of adverse pregnancy outcomes and the development of targeted interventions based on placental pathology.

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