



ORIGINAL RESEARCH PAPER

Obstetrics & Gynaecology

A STUDY ON PLACENTAL AND UMBILICAL CORD MORPHOLOGY IN MOTHERS WITH PRE-ECLAMPSIA AND ITS CORRELATION WITH FOETAL OUTCOME AT BIRTH IN A TERTIARY CARE HOSPITAL

KEY WORDS: Placenta, Foetus, pregnancy, umbilical cord

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ABSTRACT

Introduction: The placenta is a distinctive characteristic of higher mammals which is attached to the uterus and is connected to the foetus through the umbilical cord. The placenta is an organ of vital importance for the continuation of a pregnancy and foetal nutrition. In humans, after the birth of the infant, placenta is often disposed soon after parturition without adequate examination. It has been seen that many disorders of the pregnancy are associated with gross anatomical, physiological, and pathological changes in the placenta. Hypertension is one of the common complications met with in pregnancy and contributes significantly to maternal and perinatal morbidity and mortality. Of the few studies that have explored the subject, it has been seen that morphologically, the placentae of hypertensive disorders of pregnancy are smaller, with lesser weight, diameter, and thickness as compared to placentae of normal women. Even fewer studies have been done which have correlated these altered placental findings with foetal and neonatal outcomes. **Objective:** Here we did a study on placental and umbilical cord morphology in mothers with pre-eclampsia and its correlation with foetal outcome at birth in a tertiary care hospital. **Material And Methods:** The study population consisted of women of gestational age >34 weeks with diagnosed pregnancy induced hypertension or pre-eclampsia who were admitted to the labour room of the study institution for delivery. **Conclusion:** Mothers with hypertensive disorders of pregnancy tend to have a high incidence of abnormal placental and umbilical cord morphology at delivery such as lower placental weight, diameter, thickness, lower umbilical cord weight, diameter, and length.

INTRODUCTION

The placenta is a distinctive characteristic of higher mammals which is attached to the uterus and is connected to the foetus through the umbilical cord. In humans, after the birth of the infant, placenta is often disposed soon after parturition without adequate examination. However, it has been postulated that there are certain obstetric benefits to anatomically examining the placenta after delivery.

The placenta is an organ of vital importance for the continuation of a pregnancy and fetal nutrition. Placenta also represents the only point of contact between maternal and foetal tissues and plays a dominant role in the immunological acceptance by the mother of the foetal graft¹. The information provided from the pathological assessment of the placenta may provide important clinical information of both the mother and the neonate. It has been seen that many disorders of the pregnancy are associated with gross anatomical, physiological, and pathological changes in the placenta².

Hypertension is one of the common complications met with in pregnancy and contributes significantly to maternal and perinatal morbidity and mortality³. It is a sign of an underlying pathology which may be pre-existing or appears for the first-time during pregnancy. To prevent complications, it is obligatory to care properly the patients in pre-eclamptic condition, i.e., pregnancy induced hypertension (PIH). PIH is characterized by blood pressure elevation after 20 weeks of gestation that is often accompanied by proteinuria⁴. In developing nations, the incidence of the PIH is reported to be 4-18%, with hypertensive disorders being the second most common obstetric cause of stillbirths and early neonatal deaths in these countries⁵. Several important findings have contributed to our understanding of maternal genetic predisposition to developing hypertensive disorders of pregnancy such as specific patterns of genetic variant of angiotensinogen gene and quantitative trait loci on some chromosomes including 5q, 10q, and 13q⁶.

In order to properly manage hypertensive disorders in pregnancy and to prevent severe complications and sequelae such as eclampsia which are potentially fatal, a thorough understanding of the pathological processes associated with the conditions is necessary. An examination of placenta after its delivery can provide important information associated with it. However, there exists a wide gap in the available literature pertaining to the topic. Of the few studies that have explored the subject, it has been seen that morphologically, the placentae of hypertensive disorders of pregnancy are smaller, with lesser weight, diameter, and thickness as compared to placentae of normal women⁷. Hypotheses explaining this observe range from decrease in the fetomaternal blood flow in women with hypertensive disorders to production of pathologically active biomolecules that affect the overall gross morphology of the placenta itself^{8,9}. However, even fewer studies have been done which have correlated these altered placental findings with foetal and neonatal outcomes.

India has the world's largest population. As a developing country with a high burden of hypertensive disorders in pregnancy, it is imperative that research is done to explore all avenues and knowledge regarding the pathological processes and manifestations associated with the conditions¹⁰. In this context, the present study was planned in order to assess the placental characteristics of Indian women suffering from hypertensive disorders of pregnancy and to correlate their characteristics with the foetal and neonatal outcomes post-delivery.

OBJECTIVES

- The objectives of the present study were to assess:
1. Placental and umbilical cord morphology in hypertensive disorder in pregnancy
 2. Correlation of placental findings with foetal outcome

MATERIALS AND METHODS

The current study was an institution-based observational

descriptive study with a prospective longitudinal design. It was conducted in the Labour room complex under the Department of Obstetrics and Gynaecology of the North Bengal Medical College and Hospital of Darjeeling, India for 15 months from May, 2021 to July, 2022.

The study population consisted of women of gestational age >34 weeks with diagnosed pregnancy induced hypertension or pre-eclampsia who were admitted to the labour room of the study institution for delivery and gave written consent to participate in study. The study was conducted in accordance with the declaration of Helsinki.

Inclusion Criteria:

1. Gestational age >34 weeks
2. Pre-eclampsia (mild, severe)
3. Gestational hypertension

Exclusion Criteria:

1. Twin pregnancy
2. Gestational diabetes mellitus
3. Rh incompatibility
4. Systemic disorders of the cardiovascular, renal, respiratory, or GI system
5. Chronic hypertension
6. Placenta praevia
7. Autoimmune disorders
8. Eclampsia

The Institutional Ethics Committee of North Bengal Medical College & hospital, Darjeeling, reviewed and approved the project before it was carried out. All of the participants were informed in their own language about the study and informed consent were taken.

DATA ANALYSIS

The collected data were checked for consistency, completeness and entered into Microsoft Excel (MS-EXCEL, Microsoft Corp.) data sheet. Analysed with the statistical program Statistical Package for the Social Sciences (IBM SPSS, version 22). Data were organized and presented using the principles of descriptive and inferential statistics. The data were categorized and expressed in proportions. The continuous data were expressed as mean±SD. The data were graphically presented in the form of tables, vertical bars, horizontal bar, pie diagram. Where analytical statistics were performed, a p-value of <0.05 was considered to be statistically significant for the purpose of the study.

RESULTS

It was seen that most of the study participants admitted to the study institution during the study period with hypertensive disorders of pregnancy were aged 30 years or above (Table 1). The mean age of the study participants was 27.9±4.4 years.

Table 1. Distribution Of Study Participants According To Their Age (n=100)

Age (completed years)	Frequency	Percentage
20-24	23	23
25-29	36	36
≥30	41	41
Total	100	100

Most of the study participants with hypertensive disorder of pregnancy had a body mass index (BMI) between 23 and 27.5 kg/m² and the mean BMI was 25.2±4.3 kg/m². Most of the study participants hailed from rural households (66%). It was observed that most of the study participants assessed for the present study were Hindus (57%), followed by Muslims (37%) and Christians (13%). Most of the study participants belonged to families with poor socioeconomic status. It was seen that more than 60% of the study participants who were recruited in the present study were diagnosed with pre-eclampsia (Figure 1).

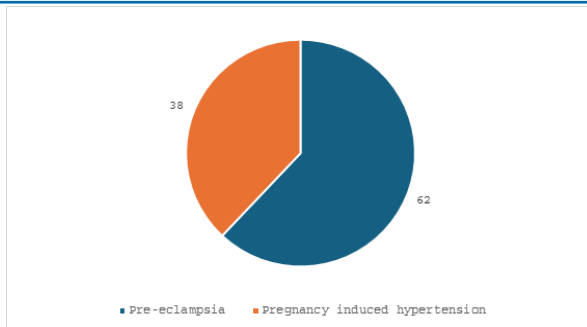


Figure 1. Distribution Of Study Participants According To Their Hypertensive Disorder (n=100)

On analysis, it was observed that 63% of the study participants had reached term pregnancy at the time of their delivery. The rest were pre-term deliveries (Figure 2).

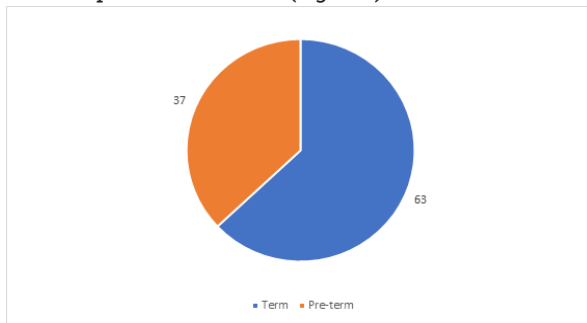


Figure 2. Distribution Of Study Participants According To Their Gestational Age At Delivery (n=100)

Most of the study participants were multigravida mothers. Only 36% of the mothers recruited for the present study were primi mothers. It was observed that most participants (53%) presenting with hypertensive disorders of pregnancy underwent delivery via lower segment caesarean section. The rest underwent delivery either via spontaneous vaginal delivery (26%) or instrumental delivery (21%). It was seen that most of the participants had a placental weight of 300 g or under at the time of the delivery with mean weight of 388.2±99.8 g (Figure 3).

Mean placental diameter and mean placental thickness of the study participants at the time of their delivery was 11.6±2.8 cm and 1.4±0.5 cm respectively. 23% of the study participants placenta showed retroplacental haematoma, 14% showed placental infarction, 18% placental calcification at the time of delivery. Mean birth weight of the neonates was 2524±581 gms and mean fetoplacental weight ratio was 6.7±1.5. It was observed that the mean length of the umbilical cords of the study participants at the time of their delivery was 55.9±2.8 cm, mean diameter of the umbilical cords was 1.6±0.4 cm and mean weight of the umbilical cords was 40.5±1.5 gms. 4% of the neonates had blue umbilical cord at delivery, signifying hypoxia, rest has pink umbilical cord. Mean APGAR score of the neonates born to the study participants at 5 mins (6.6±2.2) was higher than that at 1 min after birth (7.6±1.5). On analysis, it was seen that of the participants 37% had to have their neonates admitted to the neonatal intensive care unit (NICU) for advanced resuscitation and management of complications and 19% of the neonates died during or after delivery. On assessment of the sensitivity and specificity of placental weight, placental diameter and placental thickness in predicting the NICU admission of neonates among the study participants, it was seen that at the placental weight cut off of 315 gm or lower, the NICU admission of neonates can be predicted with a sensitivity of 73% and specificity of 56.8%, and placental diameter cut off of 10.5 cm or lower, the NICU admission of neonates can be predicted with a sensitivity of 71.4% and specificity of 56.8% while that of placental

thickness cut off of 1.25 cm or lower, the NICU admission of neonates can be predicted with a sensitivity of 52.4% and specificity of 62.2%.

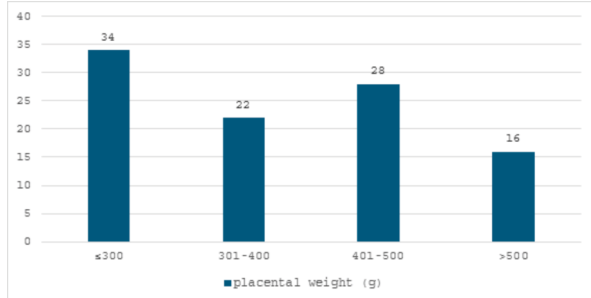


Figure 3. Distribution Of Study Participants According To The Weight Of The Placenta (n=100)

It was observed that there was no statistically significant association between the presence of retroplacental haematoma and the need for NICU admission of the neonates (p value 0.362). There was a statistically significant association between the presence of retroplacental haematoma and foetal/neonatal death (p value 0.04). There was no statistically significant association between the presence of placental infarction and the need for NICU admission of the neonates (p value 0.277). There was a statistically significant association between the presence of placental infarction and foetal/neonatal death (p value <0.001)(Table 2).

Table 2. Association Between The Presence Of Placental Infarction And Incidence Of Foetal/neonatal Death Among Study Participants (n=100)

Placental infarction	Foetal/neonatal death		Total (%)	χ ² value	p-value
	Yes (%)	No (%)			
Present	8 (57.1)	6 (42.9)	14 (100)	15.389	<0.001*
Absent	11 (12.8)	75 (87.2)	86 (100)		
Total (%)	19 (19)	81 (81)	100 (100)		

*statistically significant

There was no statistically significant association between the presence of placental calcification and the need for NICU admission (p value 0.371).

On assessment of the sensitivity and specificity of fetoplacental weight ratio in predicting the foetal/neonatal death of neonates among the study participants, it was seen that at the ratio cut off of 6.05 or lower, the foetal/neonatal death of neonates can be predicted with a sensitivity of 76.2% and specificity of 59.5%.

DISCUSSION

The hypertensive disorders of pregnancy are one of the leading causes of both maternal as well as perinatal morbidity and mortality. This is especially the case for resource poor settings such as developing countries like India. While the etiopathology of these disorders are still debated, management protocols have been developed and put in place in almost all healthcare institutions globally in order to prevent any adverse effects associated with them on the health of the mother.

However, the effect of these conditions on the placenta and the umbilical cord is poorly understood still. Even less researched is the utility of the deviation from normal limits of the placental characteristics in predicting adverse outcomes among the neonates. The present study therefore aimed to generate data in this regard by describing the placental and umbilical cord findings among mothers suffering from hypertensive disorders of pregnancy and assessing whether changes in placental morphology can effectively predict

adverse events among neonates, measured as the incidence of NICU admission after birth.

The observations of the study indicate that most mothers affected with PIH or pre-eclampsia were between 25 and 29 years of age, with a mean age of 27.9±4.4 years. The women also had BMI of 23 kg/m² or higher. These findings are similar to that already reported elsewhere. Sachan R et al. in their study on hypertensive disorders of pregnancy in North Indian women also reported that most women were aged between 25 and 30 years of age¹¹. Wolde Z et al. also reported similar age distribution among women affected with hypertensive disorders of pregnancy¹². As for the BMI status, a higher than recommended BMI status of mothers (>23 kg/m²) has been associated with an increased risk of developing both PIH as well as pre-eclampsia, as evidenced by research reported by PoonLCY et al¹³.

The study institution primarily caters to the relatively underserved populations of hilly Darjeeling district of Northern West Bengal. Therefore, as was expected, most of the study participants lived in rural areas (66%), were Hindus (57%), and were from the poorer socioeconomic strata of the population (58%). This observed socioeconomic makeup of the study population is consistent with that reported in the National level data for this area¹⁴.

It was observed that the prevalence of pre-eclampsia was higher than that of the PIH, which is consistent with the observations made by Chhatwal J et al. in their studies¹⁵. Of these mothers, 64% were multigravida mothers, and the incidence of preterm birth was 37%. Evidence regarding incidence of PIH and pre-eclampsia among multigravida mothers is conflicting, with some authors reporting higher incidence among primi mothers, others reporting findings similar to the present study, and yet others reporting almost equal incidence^{16,17,18}. On the other hand, incidence of preterm birth among mothers suffering from hypertensive disorders of pregnancy is much more well-established, with findings such as those observed in the present study being reported from multiple studies conducted both in India as well as elsewhere in the world^{19,20}.

The normal weight of a human placenta at birth ranges from 400 to around 800 gms. However, in the present study, it was observed that there was a reduced placental weight, with the mean weight of the placenta being 388.2±99.8 gms. Such reduction in the placental weight has been reported by Kambale T et al. and Marques MR et al. in their studies²¹. As discussed beforehand, hypertensive disorders of pregnancy disrupt the placental circulation itself. In absence of uninterrupted blood supply, the placental tissue fails to achieve optimal growth and development, which in turn leads to the reduction in the size as well as the weight of the placenta²². Similar reductions were also observed in the placental diameter as well as thickness, observations that conform to the findings reported by studies done on the same subject, such as by Chhatwal J et al., Kishwara S et al.^{23,24}.

With respect to the umbilical cord morphology, it was observed that the mean length of the UC was 55.9±2.8 cm, mean diameter was 1.6±0.4 cm, and mean weight was 40.5±1.5 gms. These findings are lower than the normal limits of morphology for the umbilical cord and are similar to those reported by Olaya-C M et al. in their research on the subject²⁵. Pertinently, 4 of the participants had blue discoloration of their umbilical cords, which signified significant disruption of the placental circulation and therefore hypoxic injury to the neonate.

When placental pathologies were examined, it was seen that the incidence of retroplacental haematoma was 23%, that of placental infarction was 14%, and of placental calcification was 18% which were higher than those reported by Das B et al.

in their study²⁶. Over the years, hypertensive disorders of pregnancies have been made more and more manageable due to rapid advancements in the field of obstetrics, which has led to more fetuses of mothers suffering from these conditions surviving till their birth. Therefore, pathological morphologies of placenta are more prominently expressed in births in the recent years.

Of the participants examined, it was seen that 37 births resulted in neonates needing admission to the NICU for assessment and management of severe sequelae following their birth. On analysing whether abnormal placental morphologies can predict such admissions, it was seen that when placental weight was ≤ 315 gm, severe morbidity requiring NICU admission could be predicted with 73% sensitivity and 56.8% specificity. Similar predictive values were observed for placental diameter (at ≤ 10.5 cm, 71.4% sensitivity and 56.8% specificity), but placental thickness was not found to be a good predictor of NICU admissions (at ≤ 1.25 cm, 52.4% sensitivity and 62.2% specificity). The present research is one of the only ones that has attempted the calculations of such cut-offs, and the findings indicate that placental weight and diameter at the time of delivery can be important tools to predict and therefore manage adverse events in neonates born to mothers with hypertensive disorders of pregnancy. While none of the three major placental morphological pathologies assessed as a part of the present research (i.e. retroplacental haematoma, placental infarction, and placental calcification) were found to be predictors of NICU admissions, all of them were found to be associated with neonatal death. This finding is similar to that reported by Das B et al. and Kaizad R et al. in their studies, and signifies that the presence of such morphological changes in the placenta of women affected with hypertensive disorders of pregnancy have experienced severe pathological insult to their foetus.^{26, 28} Furthermore, the fetoplacental weight ratio was also found to be an important tool for the prediction of neonatal mortality, at a ratio of ≤ 6.05 , mortality could be predicted with a sensitivity of 76.2% and specificity of 59.5%. Nobis P and Das U in their study also reported that mothers affected with PIH had a fetoplacental ratio that was decreased in than the normal, and findings of <6.0 was associated with higher neonatal mortality.²⁷

Therefore, the observations made as a part of the present study signify that mothers with hypertensive disorders of pregnancy tend to have a high incidence of abnormal placental morphology, such as lower placental weight, diameter, thickness and higher incidence of retroplacental haematoma, infarction, and calcifications. These mothers also have abnormal umbilical cord characteristics such as lower weight, diameter, and length. While placental weight, and diameter can predict adverse neonatal events, the presence of retroplacental haematoma, infarction, calcification, and fetoplacental weight ratio of ≤ 6.05 were found to be valuable predictors of fetal/ neonatal death after delivery.

CONCLUSION

From this study it can be concluded that mothers with hypertensive disorders of pregnancy tend to have a high incidence of abnormal placental and umbilical cord morphology at delivery such as lower placental weight, diameter, thickness, lower umbilical cord weight, diameter, and length and higher incidence of retroplacental haematoma, infarction, and calcifications. , and these abnormal placental morphologies can be utilised to predict neonatal death with fair amount of accuracy. Furthermore, the fetoplacental weight ratio was also found to be an important tool for the prediction of neonatal mortality, at a ratio of ≤ 6.05 , mortality could be predicted with a sensitivity of 76.2% and specificity of 59.5%. While none of the three major placental morphological pathologies assessed as a part of the present research (i.e. retroplacental haematoma, placental infarction, and placental calcification) were found to be predictors of

NICU admissions, all of them were found to be associated with neonatal death.

LIMITATION

The primary limitation of the present study was its relatively small sample size. The present study was conducted in a single institution during a year where the COVID-19 pandemic was ongoing, which limited the attendance and admission of mothers with hypertensive disorders of pregnancy, unless they were at a much-advanced stage of the conditions. Research conducted in multiple study centres with a larger study population would have provided with better data pertaining to the topic of study.

Another limitation of the present study was the fact that since the study was conducted in a single labour room of northern West Bengal, the results of the present study reflect only the situation of this particular study population and has therefore limited generalizability on to the greater Indian population. Finally, only the neonatal deaths or NICU admissions were assessed as a part of the present study, and persistent abnormalities in either the mother or the neonate or both could not be assessed due to resource and time constraints. Future research is therefore warranted on the topic to provide further evidence with regards to the abnormal placental morphology and its predictive value in Obstetrics.

Funding Declaration

There was no any funding source for this study.

Conflict Of Interest

Authors have no conflict of interest

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