Original Article
DOI: https://doi.org/10.70749/ijbr.v3i5.1385

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Frequency of Various Macroscopic Placental Pathologies in Patients with Intrauterine Growth Retarded Baby with Preeclampsia

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ARTICLE INFO

Keywords: Intrauterine Growth Retardation, Placental Disease, Preeclampsia.

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Declaration

Authors' Contribution: The following outlines the key roles undertaken by the authors in preparing this manuscript. **Dr Diya Ajmal** was responsible for designing the study, composing the manuscript, and collecting data from the hospital. **Dr Samina Aliya Sabir** participated in shaping the study design, contributing to manuscript writing, and performing data analysis and interpretation.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 05-04-2025 Revised: 24-04-2025
Accepted: 08-05-2025 Published: 24-05-2025

ABSTRACT

Background: Intrauterine growth retardation is a common condition with the main etiology of placental insufficiency, leading to low birth weight and long-term health implications. Placental pathology is the main cause and is detectable by gross examination. **Objectives:** To determine frequency of various macroscopic placental pathologies in patients with intrauterine growth retarded baby with preeclampsia. **Study design:** Cross-sectional study. **Place and duration of study:** Lady Reading Hospital, Peshawar from October-2024 to March-2025. **Methods:** A total of 140 women who gave birth to intrauterine growth retorted baby with preeclampsia were included. After the delivery of placenta, placenta was examined thoroughly for gross morphological features to assess for macroscopic pathologies of placenta related to intrauterine growth retardation of the baby. Frequency of these macroscopic pathologies was stratified by age, weeks of gestation and cause of IUGR and post-stratification comparison was performed by using Chi-square test. **Results:** Median age of the mother was 25.00 (8.00) years. Median weight of the baby was 2.10 (0.30) kg. Most common cause of intrauterine growth retardation was maternal anemia found in 67 (47.90%). Amongst all IUGR cases, placenta was macroscopically normal in 11 (7.90%) patients while there were macroscopic pathologies on placenta in 129 (92.10%) patients. Amongst these patients (n = 129), most common macroscopic pathology was two vessel umbilical cord found in 38 (29.47%) cases followed by eccentric attachment site of umbilical cord in 35 (27.13%) cases. **Conclusion:** In cases of intrauterine growth retardation macroscopic placental pathologies are common and were observed in 92.10% cases.

INTRODUCTION

Intrauterine growth retardation (IUGR) is a postnatal condition in which birth weight of a new born baby is below the 10th percentile for its gestational age. [1, 2] It is a fairly common condition that has been reported to affect around 24% of all the pregnancies all around the world. [3] In Pakistan, a study addressed the burden of this common fetal condition and reported it at approximately 10%. [4] IUGR is a multi-factorial condition which is influenced by a variety of factors but one of the main reasons involved in its pathophysiology is placental insufficiency that occurs due to restricted blood flow to the placenta leading to impairment of availability of required nutrients to the growing fetus. [5] This can occur due to a variety of maternal conditions (like pre-eclampsia, eclampsia), genetic syndromes, environmental factors (like nutritional status of mother, smoking, living conditions, parental stress, exposure to pollutants, etc.) and congenital birth defects. [6, 7]

It is important that IUGR should be diagnosed earlier in its course so that immediate interventions should be carried out to prevent its short and long term impacts on the physiological functions and vital systems of the human body. Despite increased risk of infant mortality, it can lead to serious problems in adulthood too including increased risk of developing hypertension, coronary disease (due to *thrifty* phenotype), chronic kidney disease (CKD), non-alcoholic fatty liver disease (NAFLD), obesity, metabolic syndrome, type 2 diabetes mellitus, impaired pulmonary function, impaired immunity and neurocognitive disabilities (including learning disabilities, behavioral disorders, visuo-motor and neuro-motor impairment, cognitive dysfunction and cerebral palsy). [8]

One of the most important factors that leads to development of IUGR is placental pathologies. For this purpose, careful naked eye examination of delivered placenta is of utmost importance as this can provide

subjective evidence of IUGR. A number of such pathologies have been reported in literature including inflammation of the tissue or vasculature of the placenta, placental infarcts, placenta accreta, chorioamnionitis, abnormal weight of the placenta and abnormality in the gross morphology of placental vasculature. [9]

Since local and regional data in this regard is lacking and even the international studies addressing this important obstetric aspect are few in number, this study was conducted with the aim to determine frequency of various macroscopic placental pathologies in pregnant women with preeclampsia who gave birth to an intrauterine growth retarded baby.

METHODOLOGY

This cross-sectional study was conducted at Obstetrics & Gynecology Department of Lady Reading Hospital, Peshawar from October-2024 to March-2025 after getting approval from institutional ethical committee (Ref No: 824/LRH/MTI dated 24-07-2024). Sample size calculation was performed using Raosoft ® sample size calculator. Sample size calculation was performed by using confidence level of 95%, precision of 4% and anticipated population proportion of 6.25%. [10] This gave a sample size of 140 which was selected by using non-probability consecutive sampling technique.

All pregnant females, aged 16-40, who give birth to IUGR baby with preeclampsia were included in the study. Diagnosis of IUGR was made if the birth weight of baby was below the 10th percentile of normal birth weight being born at term (37 weeks gestation or above). Diagnosis of preeclampsia was made by presence of two readings of more than 140mmHg systolic and 90mmHg diastolic BP which were recorded at six hours apart along with the laboratory evidence of proteinuria. Babies who were born preterm, cases of multi-fetal pregnancy and babies having congenital genetic/chromosomal abnormalities were excluded.

Prior to inclusion, a consent form was presented to the pregnant women to be read and signed by them after which demographic data including age of mother, week of gestation, weight of placenta, weight of baby and cause of IUGR was documented. After undergoing delivery of placenta, placenta was examined thoroughly for gross morphological features to assess for macroscopic pathologies of placenta related to IUGR in preeclampsia women and the findings were documented in a predesigned proforma.

Analysis of the collected data was performed by inputting the data in Statistical Package for Social Sciences (SPSS) software version 20. Upon analysis of quantitative variables by Shapiro-Wilk test; age of mother, week of gestation, weight of placenta and weight of baby were found to have non-normal distribution and were thus represented as median interquartile range (IQR). Qualitative data was represented as frequency followed by percentage. Frequency of macroscopic pathologies of placenta was stratified by age of mother, weeks of gestation and cause of IUGR and post-stratification comparison was performed by using Chi-square test. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

In this study, the median age of the mothers was 25 years with an interquartile range (IQR) of 8 years, with 70% being younger than 30 years and 30% aged 30 years or above. The median gestational age was 39 weeks (IQR 2), with 66.4% of births occurring between 37–39 weeks and 33.6% between 40–42 weeks. The median placental weight recorded was 498.50 grams (IQR 92.00), while the median baby weight was 2.10 kilograms (IQR 0.30). Maternal anemia was identified as the most frequent cause of IUGR (47.9%), followed by idiopathic causes (37.9%), eclampsia (11.4%), and elderly maternal age (2.9%) (as shown in Table 1).

Table 1

Baseline Parameters (n = 140)

Parameters	Median (IQR); n (%)
Median age of mother	25.00 (8.00) years
< 30 years	98 (70.00%)
≥ 30 years	42 (30.00%)
Median week of gestation	39.00 (2.00) weeks
37-39 years	93 (66.40%)
40-42 years	47 (33.60%)
Median weight of placenta	498.50 (92.00) grams
Median weight of baby	2.10 (0.30) kg
Cause of IUGR	
Maternal anemia	67 (47.90%)
Idiopathic	53 (37.90%)
Eclampsia	16 (11.40%)
Elderly mother	4 (2.90%)

Regarding macroscopic placental abnormalities, the most prevalent finding was a two-vessel umbilical cord in 29.47% of cases, followed by eccentric cord attachment in 27.13%, fibrin deposition on the placental surface in 15.50%, placental infarction in 12.40%, velamentous cord insertion in 10.85%, and umbilical cord torsion in 4.65% of cases (as shown in Table 2).

Table 2

Distribution of Frequency of Macroscopic Pathologies of Placenta

Macroscopic pathology	n (%)
Two vessel umbilical cord	38 (29.47%)
Eccentric attachment site of umbilical cord	35 (27.13%)
Fibrin deposition on placental surface	20 (15.50%)
Placental infarction	16 (12.40%)
Velamentous attachment site of umbilical cord	14 (10.85%)
Umbilical cord torsion	6 (4.65%)

When stratified by maternal age, macroscopic pathologies were more prevalent among mothers aged 30

years or above, with two-vessel umbilical cords observed in 42.86% of older mothers compared to 20.41% in younger mothers (p = 0.162). Eccentric cord attachment was more common in younger mothers (27.55%) than older (19.05%), whereas fibrin deposition (16.33% vs. 9.52%), placental infarction (13.27% vs. 7.14%), velamentous cord insertion (9.18% vs. 11.90%), and umbilical cord torsion (4.08% vs. 4.76%) did not differ significantly. Similarly, stratification by gestational age showed a slightly higher frequency of two-vessel umbilical cords in later gestation (31.91% vs. 24.73%, p = 0.490). Eccentric attachment (27.66% vs. 23.66%), velamentous insertion (10.64% vs. 9.68%), and torsion (6.38% vs. 3.23%) were also more common in later gestation, while fibrin deposition (10.64% vs. 16.13%) and infarction (4.26% vs. 15.05%) were more frequent in earlier gestation.

Finally, when analyzed by cause of IUGR, two-vessel cords were significantly more common in cases due to elderly mothers (50.00%) and maternal anemia (31.34%) compared to idiopathic (18.87%) and eclampsia (31.25%) (p = 0.003). Fibrin deposition was notably high in maternal anemia (26.87%) but absent in eclampsia and elderly mothers. Placental infarction was predominantly observed in idiopathic causes (22.64%), while velamentous cord insertion was highest among elderly mothers (25.00%). Umbilical cord torsion was found in 9.43% of idiopathic cases but was absent in eclampsia and elderly mothers (as shown in Table 3 and Graph 1).

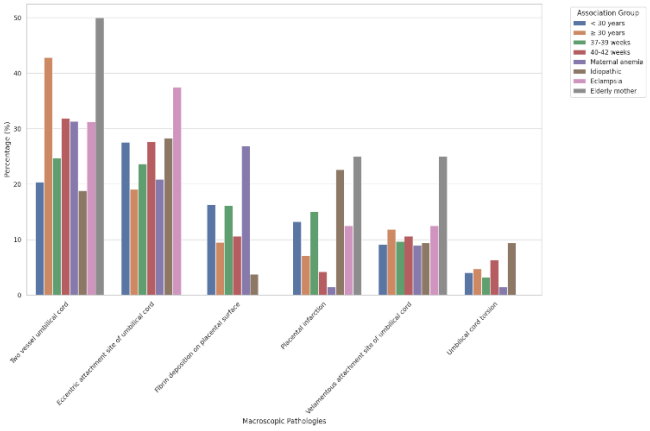
Table 3

Stratification of Macroscopic Pathologies of Placenta by Age of the Mother, Week of Gestation and Cause of IUGR

Stratification by Age of Mother			
Macroscopic Pathologies	**< 30 years (n = 98)**	**≥ 30 years (n = 42)**	**p-value**
Two vessel umbilical cord	20 (20.41%)	18 (42.86%)	0.162
Eccentric attachment site of umbilical cord	27 (27.55%)	8 (19.05%)	
Fibrin deposition on placental surface	16 (16.33%)	4 (9.52%)	
Placental infarction	13 (13.27%)	3 (7.14%)	
Velamentous attachment site of umbilical cord	9 (9.18%)	5 (11.90%)	
Umbilical cord torsion	4 (4.08%)	2 (4.76%)	
Stratification by Week of Gestation			
Macroscopic Pathologies	**37-39 weeks (n = 93)**	**40-42 weeks (n = 47)**	**p-value**
Two vessel umbilical cord	23 (24.73%)	15 (31.91%)	0.490
Eccentric attachment site of umbilical cord	22 (23.66%)	13 (27.66%)	
Fibrin deposition on placental surface	15 (16.13%)	5 (10.64%)	
Placental infarction	14 (15.05%)	2 (4.26%)	
Velamentous attachment site of umbilical cord	9 (9.68%)	5 (10.64%)	
Umbilical cord torsion	3 (3.23%)	3 (6.38%)	
Stratification by cause of IUGR					
Macroscopic pathology	**Maternal anemia (n = 67)**	**Idiopathic (n = 53)**	**Eclampsia (n = 16)**	**Elderly mother (n = 4)**	**p-value**
Two vessel umbilical cord	21 (31.34%)	10 (18.87%)	5 (31.25%)	2 (50.00%)	0.003
Eccentric attachment site of umbilical cord	14 (20.90%)	15 (28.30%)	6 (37.50%)	0 (0.00%)	
Fibrin deposition on placental surface	18 (26.87%)	2 (3.77%)	0 (0.00%)	0 (0.00%)	
Placental infarction	1 (1.49%)	12 (22.64%)	2 (12.50%)	1 (25.00)	
Velamentous attachment site of umbilical cord	6 (8.96%)	5 (9.43%)	2 (12.50%)	1 (25.00)	
Umbilical cord torsion	1 (1.49%)	5 (9.43%)	0 (0.00%)	0 (0.00%)	

Graph 1

Association of Macroscopic Pathologies of Placenta with Demographics



DISCUSSION

IUGR is common neonatal problem globally affecting approximately 10% of the pregnancies and is much more prevalent in underdeveloped nations. [11, 12] Present study focused on a unique aspect of IUGR which is the macroscopic pathological changes with which it is associated. In present study, to define presence of IUGR, birth weight less than the tenth centile of normal birth weight being born at term was used as a reference which align with the standardized and globally accepted definition of this condition. [13, 14] Similarly, in order to define pre-eclampsia, which is a known common cause of IUGR [15], standard definition of hypertension alongside proteinuria detected after twentieth week of gestation was used for diagnosis. [16]

Our study results were consistent with the growing body of evidence highlighting significant placental abnormalities associated with intrauterine growth restriction (IUGR). Involving 140 cases, our median maternal age was 25 years (IQR 8), with 70% younger than 30 years and 30% aged 30 or above, and a median gestational age of 39 weeks (IQR 2). The median placental weight recorded was 498.5 grams (IQR 92.0),

and median neonatal weight was 2.10 kilograms (IQR 0.30). These values align well with previous reports; for example, Ghomian et al. [17] reported a mean placental weight of 440 g in IUGR versus 585 g in controls, Khajuria et al. [18] found an average placental weight of 425 g in IUGR compared to 550 g, and Agrawal et al. [19] reported 363.5 g versus 547.2 g, confirming the consistent reduction in placental mass associated with IUGR. Maternal anemia was the leading cause of IUGR in our study (47.9%), followed by idiopathic causes (37.9%) and eclampsia (11.4%). This agrees with Shinde et al. [21] who documented anemia in 43% of cases and preeclampsia in 18%, and Kiran et al. [20] emphasizing anemia and hypertensive disorders as prominent maternal contributors to placental pathology. Regarding macroscopic placental abnormalities, the prevalence of two-vessel umbilical cords was 29.47%, eccentric cord attachment 27.13%, fibrin deposition 15.5%, and placental infarction 12.4%. These findings are consistent with Ghomian et al. [17] who reported significantly higher infarction and fibrin deposition rates in IUGR placentas; Khajuria et al. [18] found infarction in 53.3% of IUGR versus 6.6% controls, and fibrinoid necrosis was also significantly elevated. Park et al. [23] observed increased decidual vasculopathy and villous fibrosis (31.1%), while Kiran et al.[20] reported increased syncytial knots (22.04 ± 5.21 vs. 13.84 ± 4.41) and reduced vascularity in IUGR placentas. Stratification by maternal age showed two-vessel cords were more prevalent in mothers aged ≥30 years (42.86%) compared to younger mothers (20.41%, p = 0.162). This trend is supported by Agrawal et al.[19] who observed higher rates of vascular anomalies in older mothers, and Vișan et al.[22] who noted similar correlations between abnormal cord insertions and advanced maternal age. Other pathologies such as fibrin deposition (16.33% vs. 9.52%) and infarction (13.27% vs. 7.14%) also trended higher in younger mothers, though without statistical significance, consistent with Kiran et al.[20] who found variable lesion distribution irrespective of age. Gestational age stratification revealed slightly increased two-vessel cords in later gestation (31.91% vs. 24.73%, p = 0.490) and higher eccentric cord attachments and torsion, while fibrin deposition (10.64% vs. 16.13%) and infarction (4.26% vs. 15.05%) were more common earlier. This pattern echoes Park et al.[23] who demonstrated progressive placental pathology as gestation advances, affecting fetal growth potential. Notably, cause-specific analysis showed significantly higher two-vessel cord incidence in elderly mothers (50%) and maternal anemia (31.34%) compared to idiopathic (18.87%) and eclampsia cases (31.25%, p = 0.003). Fibrin deposition was pronounced in maternal anemia cases (26.87%) but absent in eclampsia and elderly mothers. Idiopathic cases showed the highest placental infarction (22.64%), and velamentous cord insertion was most frequent in elderly mothers (25%). Umbilical cord torsion occurred only in idiopathic cases (9.43%). These findings resonate with Shinde et al.[21] who also reported anemia and advanced maternal age as major factors influencing placental vascular abnormalities, and Kiran et al.[20] who emphasized hypoxic injury markers as critical in IUGR etiology. Differences between our study and some previous reports, such as somewhat higher median placental weight and lower infarction rates compared to Khajuria et al.[18] and Agrawal et al.[19] may reflect demographic differences, sample size variability, and distinct histopathological assessment criteria or timing.

Overall, our data, alongside prior studies, reinforce those placental abnormalities—including reduced placental weight, two-vessel cords, infarction, fibrin deposition, and abnormal cord insertions—are hallmark features of IUGR. These pathologies likely represent the structural and functional consequences of uteroplacental insufficiency and contribute to impaired fetal growth. The subtle variations observed across stratifications highlight the multifactorial nature of IUGR pathophysiology and underscore the importance of detailed placental evaluation in clinical management. There are certain limitations of this study that have to be kept in mind while interpreting the findings. It is a single-center study, and this can limit generalizability of the findings in relation to larger groups with diverse demographic and clinical characteristics. Sample size, while adequate, was relatively small and may not be representative of the full range of placental pathologies of IUGR. Besides, its cross-sectional design does not facilitate analysis of temporal changes in placental pathology over gestation. Finally, there may have been variability in histopathological evaluation and timing of placental examination that also could have influenced observed lesion frequencies. Multicenter trials with larger cohorts and longitudinal designs are needed in the future for verification and extension of the findings.

CONCLUSION

We have identified that certain placental abnormalities in macroscopic and microscopic findings, in the form of vascular and structural changes, are closely associated with intrauterine growth restriction. Placental pathologies are indicative of placental dysfunction and have a significant causative role in fetal growth restriction. Thorough examination of placental morphology and histopathology can be beneficial for their diagnosis and treatment, and this brings placental examination into the forefront of securing better outcomes of pregnancy.

Acknowledgment

We thank the Department's health team for their meticulous efforts in ensuring accurate records and efficient patient information organization. Their dedication was vital to this task.

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