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Gross placental anomalies and their association with newborn outcomes: A cross-sectional study

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Abstract

Background and objective: Correlating gross placentas abnormalities with perinatal outcomes is crucial for understanding their clinical impact. The aim of this study was to determine the prevalence of gross placentas anomalies within a sample of Kurdish women after delivery and subsequently assess the association between these anomalies with early neonatal outcomes.

Methods: A cross-sectional study was conducted at the labor ward of Maternity Teaching Hospital, Erbil city, Kurdistan region, Iraq between 15th of August 2023, and 14th of August 2024 on 500 freshly delivered placentas from term newborns. Placentas morphological and structural anomalies were identified and correlated with maternal demographic and early neonatal outcomes.

Results: Gross placental anomalies were found in (45.2%) while structural and morphological anomalies were detected in (30.4%), (22.6%) respectively. Common structural anomalies included opaque membranes (15.2%) and varices (6.2%).

Placental morphological anomalies (weight, diameter, and thickness) were linked to maternal preeclampsia, diabetes, hypothyroidism, and anemia. Gross anomalies significantly impacted early neonatal outcomes (Apgar scores, birth weight, NICU admission, neonatal deaths).

Conclusion: A significant placental abnormalities are common and strongly correlated with adverse neonatal outcomes, particularly when maternal medical disorders are present. Therefore placental assessment is vital for predicting and preventing these outcomes.

Keywords: Placenta; Accessory lobe; Circumvallate placenta; Birth weight; Maternal weight.

Introduction

During pregnancy, the placenta, a temporary fetal organ, plays a fundamental role in the wellness of both the fetus and the mother. Its primary function involves enabling the passage of nutrients and oxygen from the maternal blood to the fetal system, and conversely, the elimination of fetal metabolic byproducts.[1] Examining the placentas after delivery is valuable for determining the causes of antepartum, postpartum, and neonatal complications. This provides crucial diagnostic information that requires immediate action for both the mother and newborn, offering insights into their likely outcomes.[2]

Perinatal outcome of newborns is greatly influenced by abnormalities of placenta.[3] The placenta composed of the umbilical cord, membranes, and parenchyma, acts as the vital interface between mother and fetus. Consequently, maternal or fetal health issues can leave traces within it, and conversely, placental abnormalities can impact both.[4]

It may reveal causes pregnancy loss,

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maternal infection, suspected abruption, fetal growth restriction, preterm birth, non-reassuring fetal heart testing requiring urgent delivery, preeclampsia with severe features, or neonates with early evidence of multi-organ system failure including neurologic compromise.[5] In cases of fetal or neonatal death, placental examination is crucial for autopsy.[4] Not all placentas require pathologic examination. However, prioritizing certain cases is important. Placentas should be examined when there are specific indications. These include maternal comorbidities or pregnancy complications. This approach improves the relevance of placental examination to clinical care.[5]

While studies have examined specific placental anomalies and their associations with maternal disorders,[4,6-9] a comprehensive analysis of overall rate of gross placental anomalies within a single population sample, has not been previously published. Therefore, this research represents the first attempt to determine the prevalence of gross placental anomalies within this specific population and subsequently assess the correlation between identified anomalies and early neonatal outcomes.

Methods

Study Design and Setting:

This was a cross-sectional study conducted at labor wards of Maternity Teaching Hospital, Erbil city, Kurdistan region, Iraq between August 2023, and August 2024, to investigate the association between gross placental anomalies and neonatal outcomes.

Sample size and study population:

A convenience sample of 500 placentas and their corresponding neonates was obtained from women who delivered at the hospital during the study period. Postpartum examination of the placentas was performed to identify any structural or morphological anomalies with a focus on shape, size and umbilical cord insertion.

Inclusion Criteria: Singleton pregnancies at ≥37-41 week's gestation, delivered vaginally or caesarean section. Having any medical disorders during pregnancy, availability of the placentas for gross examination and accepted to participate voluntarily.

Exclusion Criteria: Multiple pregnancies, intrauterine fetal deaths before delivery, preterm deliveries < 37 weeks or pregnancies of > 41 weeks gestation. Antepartum haemorrhage, major congenital anomalies, placentas with insufficient tissue for gross examination, retained placentas, manual removal of placentas and women refused to participate were excluded.

Data Collection:

Maternal demographic data, including age, parity, blood group and Rh, being smoker or not were recorded. Gestational age calculated from first day of last menstrual cycle confirmed by ultrasound at 11-14 weeks gestation.[10] Current delivery (vaginal or cesarean section), having medical disorders in pregnancy, including (pre-eclampsia, gestational diabetes, anemia), were recorded through postpartum interviews. Pre-pregnancy or early first-trimester weight (kg) and height (meter) were recorded, and body mass index (BMI) was calculated using the formula: BMI = weight (kg) / height (m^2). BMI was then categorized as:

Normal weight (18.5–24.9 kg/m^2), Overweight (25–29.9 kg/m^2), and Obese (≥30 kg/m^2), consistent with established.[11] Placentas anomaly findings and neonatal outcome data were recorded concurrently.

Placentas Examination for Anomalies:

Immediately following delivery, gross examination of the placentas was done within 5 min of by trained obstetric residents according to a standardized protocol to identify any gross anomalies. Examiners were blinded to neonatal outcomes and maternal medical histories. The fresh placentas were rinsed with running tap water to remove any blood clots adhering to the maternal side. Membranes were then carefully removed,

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with their opacity or transparency documented. The umbilical cord was detached at its insertion point on the placentas using sterile scissors after clamping it. The following placental characteristics were assessed:

Placentas weight:
Each trimmed placenta i.e., the placentas after removal of the cord and membranes was weighed precisely. The placentas were placed on a bassinet baby weighing scale (corrected to zero), to ensure accuracy, weights were recorded three times, rounded to the nearest gram, and the average was calculated. This weighing procedure was performed promptly, within thirty minutes of delivery.

Placentas disc:
involved measurement of the placentas diameter (length x width) and thickness in centimeter using a tape measure.

Ranges of placentas weight, thickness and diameter:
The normal values (range) of the placental weight, diameter, and thickness were assessed by calculating the 5th and the 95th percentiles of the weight, diameter, and thickness of women with no medical problems and no structural placentas anomalies. Accordingly, the normal range of placentas weight was 407.5-900 g, placentas diameter was 14.625-23 cm, and placentas thickness was 2-3.275. Any value beyond these ranges was considered an abnormal morphological anomaly.

Gross placentas morphological anomalies:
involved abnormalities in the diameter, thickness and weight of the placentas.

Structural placentas anomalies:
Examination of the placentas included the presence of two amniotic membranes were noted. The shape of the disc was assessed being discoid normal placentas (a flat, circular or oval disc) or multiple lobed placentas.

Multiple lobed placentas included:
A bi-lobed placenta which was defined as a placenta with 2 roughly equal-sized lobes separated by a membrane.[12]

Succenturiate placentas:
The succenturiate placentas were defined as one or more accessory lobes present in the membranes apart from the main placental body.[13]

Circumvallate placentas: Was defined as an extra chorial, annularly-shaped placenta with raised edges composed of a double fold of chorion, amnion, degenerated decidua, and fibrin deposits.[14]

Umbilical cord insertion anomalies:
Velamentous: Defined as the umbilical cord inserts into the fetal (chorio-amniotic) membranes outside the placentas margin and then travels within the membranes to the placentas (between the amnion and the chorion)[15].

Marginal cord: Defined as insertion of the umbilical cord within <2 cm from the placentas margin.[15]

Thin cord syndrome: At the site of placental insertion defined as decrease in the cross sectional diameter of the umbilical cord < 1.0 cm (normal: 1.25 - 2.5 cm) at term with less Wharton's Jelly.[16]

Neonatal Outcome Assessment:
Neonatal outcomes were analyzed, including birth weight, NICU admission, and Apgar scores at 1 and 5 minutes. Apgar scores were categorized as low (≤3), moderate (4-6), or reassuring (≥7),[17] and birth weight was classified as low (1500-2499 grams) or normal (2500-3999 grams).[18]

Ethical approval:
The research proposal was approved by the Research Ethics Committee/College of Medicine/Hawler Medical University (Nb. 5/4 on May 23, 2021.This study was performed in accordance with the ethical standards outlined in the Declaration of Helsinki. Participants provided informed consent after receiving comprehensive information about the study, including their right to withdraw from the study at any time.

Statistical analysis:
Data were analyzed using the Statistical Package for Social Sciences (SPSS,

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version 26). The Chi-square test of association was used to compare the proportions of two or more groups. Fisher's exact test was used when the expected frequency (value) was less than 5 of more than 20% of the cells of the table. An unpaired t-test was used to compare two means. A *P*-value of ≤0.05 was considered statistically significant.

Results

A total of 500 women participated in this study. The prevalence rates of gross placentas, structural and morphological anomalies were 45.2%, 30.4% and 22.6% respectively (Figure 1).

The age ranged between 19 – 38, with a mean of 28.2 ±5.15 years. No significant differences were observed between women with gross placentas anomalies and women with normal placentas regarding maternal weight at delivery, gestational age, and maternal age (Table 1).

Table 1 Mean maternal characteristic of study participants

	Gross anomalies		No anomalies		
	Mean	**(SD)**	**Mean**	**(SD)**	***P*-value***
Age (years)	28.11	(4.93)	28.23	(5.34)	0.794
Weight (Kg)	89.08	(12.31)	89.00	(9.97)	0.938
Gestational age (weeks)	38.58	(1.21)	38.41	(1.12)	0.110

*By unpaired t-test.

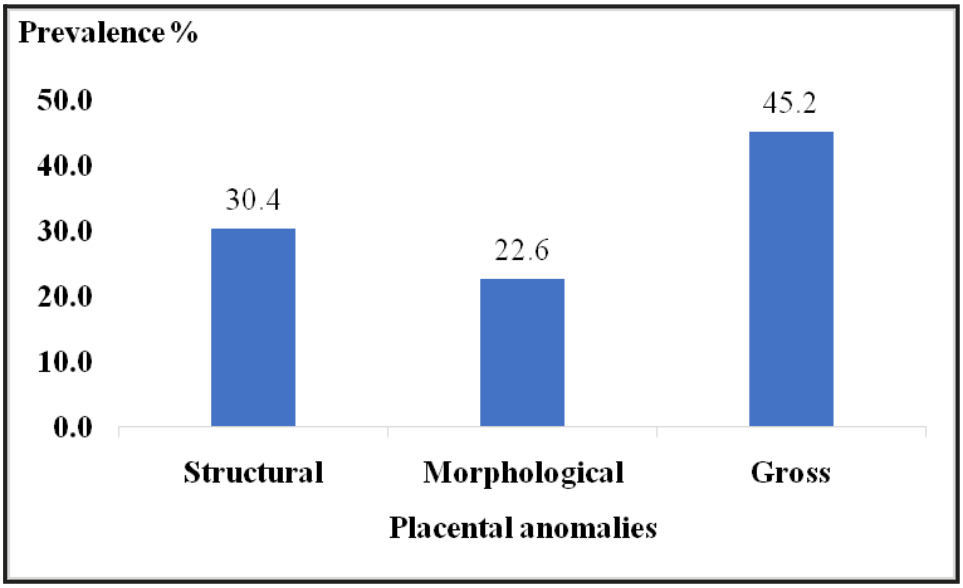

Figure 1 Prevalence of Placentas Anomalies

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Types of structural placentas anomalies presented in Table 2.
Placental weight, diameter and thickness were identified according to the normal ranges in the healthy pregnant ladies in the sample size (Table 3).

Table 2 Types of structural placentas anomalies

Variables	No.	%
Opaque membrane	76	15.2
Thin cord syndrome	31	6.2
Accessory lobe	27	5.4
Marginal cord insertion	24	4.8
Mass in placentas	15	3.0
Velamentous cord insertion	8	1.6
Circumvallate placentas	6	1.2
No two layer membrane	6	1.2

Table 3 Types of morphological placental anomalies

	No.	%
Placental weight		
Low	35	7.0
Normal	439	87.8
High	26	5.2
Placental diameter		
Low	25	5.0
Normal	440	88.0
High	35	7.0
Placental thickness		
Low	28	5.6
Normal	436	87.2
High	36	7.2
Total	500 (11)	100.0

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Table 4 demonstrates that placental weight, thickness, and diameter are affected by maternal diabetes, hypothyroidism, and anemia.
Table 5 shows the APGAR Scores among the study participants.

Table 4 Morphological placentas anomalies by medical conditions during pregnancy

	None	Anemia	DM	PIH	Hyper-thyrodism	Hypothyrodism	Total	*P*-Value
Placental variables	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	
Weight								
Low	18 (5.6)	7 (14.3)	2 (4.1)	0 (0.0)	0 (0.0)	0 (0.0)	34 (6.9)	
Normal	291 (90.9)	41 (83.7)	37 (75.5)	52 (86.7)	7 (100.0)	4 (80.0)	432 (88.2)	
High	11 (3.4)	1 (2.0)	10 (20.4)	1 (1.7)	0 (0.0)	1 (20.0)	24 (4.9)	0.001
Diameter								
Low	15 (4.7)	5 (10.2)	2 (4.1)	2 (3.3)	0 (0.0)	0 (0.0)	24 (4.9)	
Normal	289 (90.3)	42 (85.7)	32 (65.3)	57 (95.0)	7 (100.0)	5 (100.0)	432 (88.2)	
High	16 (5.0)	2 (4.1)	15 (30.6)	1 (1.7)	0 (0.0)	0 (0.0)	34 (6.9)	< 0.001
Thickness								
Low	14 (4.4)	8 (16.3)	1 (2.0)	4 (6.7)	1 (14.3)	0 (0.0)	28 (5.7)	
Normal	289 (90.3)	39 (79.6)	33 (67.3)	56 (93.3)	6 (85.7)	5 (100.0)	428 (87.3)	
High	17 (5.3)	2 (4.1)	15 (30.6)	0 (0.0)	0 (0.0)	0 (0.0)	34 (6.9)	< 0.001
Total	320 (100.0)	49 (100.0)	49 (100.0)	60 (100.0)	7 (100.0)	5 (100.0)	490 (100.0)	

*Calculated by Fisher's exact test.

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Table 5 The distribution of the study participants according to their APGAR score outcomes

	Prevalence of Gross Placental Anomalies			
	Yes	**No**	**Total**	***P* value**
	No. (%)	**No. (%)**	**No. (%)**	
APGAR 1st minute				
≤3	9 (4.0)	3 (1.1)	12 (2.4)	
4-6	110 (48.7)	65 (23.7)	175 (35.0)	
≥7	107 (47.3)	206 (75.2)	313 (62.6)	<0.001*
APGAR 5th minute				
≤3	1 (0.4)	0 (0.0)	1 (0.2)	
4-6	30 (13.3)	7 (2.6)	37 (7.4)	
≥7	195 (86.3)	267 (97.4)	462 (92.4)	<0.001**
Birth Weight (Kg)				
< 2.5	40 (17.7)	12 (4.4)	52 (10.4)	
2.5-3.9	133 (58.8)	221 (80.7)	354 (70.8)	
≥ 4	53 (23.5)	41 (15.0)	94 (18.8)	<0.001*
Admission to NICU				
Yes	126 (55.8)	82 (29.9)	208 (41.6)	
No	100 (44.2)	192 (70.1)	292 (58.4)	<0.001*
Early Neonatal Death				
Yes	15 (6.6)	4 (1.5)	19 (3.8)	
No	211 (93.4)	270 (98.5)	481 (96.2)	0.003*
Total	226 (100.0)	274 (100.0)	500 (100.0)	

*Calculated by chi-square test. **Calculated by Fisher's exact test. NICU: Neonatal Intensive Care Unite

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Discussion

Gross abnormalities during placental examination is a clinical significant issue as it elucidate factors impacting pregnancy outcomes, guide postpartum decision-making, and offer diagnostic clues to various clinical problems.[20]

In this study, 45% of 500 deliveries at a public tertiary hospital in Kurdistan region, Iraq, presented with gross placental anomalies. This prevalence significantly surpasses the 2-4% reported in a broad systematic review.[21] The difference may be attributable to our study's high-risk delivered women population and our expanded definition of placental anomalies, which included morphological measurements alongside structural defects. Given that the systematic review primarily addressed structural anomalies, our broader criteria likely resulted in a higher prevalence. Therefore, the interpretation of our findings necessitates careful consideration of the study's setting, definitions, and regional context.

Placentasmorphology, assessed by post-delivery weight and dimensional measurements, provides a record of the placental development history. Specifically, weight reflects overall growth, while factors like: dimensions, including thickness and shape, along with vascular features like the number of blood vessels, cord insertion, and villous arborization illustrates the efficiency of nutrient transfer across the placental surface. Abnormalities in these morphological features can negatively impact fetal growth and fetal outcomes.[22]

A population-based case-control study demonstrated that specific placentas pathologies are significantly associated with both stillbirth and fetal growth abnormalities. The study identified a range of placentas findings, including single umbilical artery, velamentous cord insertion, terminal villous immaturity, retroplacental hematoma, parenchymal infarction, intraparenchymal thrombosis, avascular villi, placentasedema, and abnormal placentas weight and birth weight-to-placentas weight ratio, which were significantly linked to stillbirths, especially those involving fetuses with growth outside the normal range. This suggests that placentas anomalies can impact fetal outcomes through distinct mechanisms, affecting either survival or growth restrictin.[24]

Consistent with previous publications, current study found a significant association between morphological placentas anomalies and PE or PIH. The observed anomalies, frequently linked to reduced placentas weight, suggest a compromised placentation. This pattern, also seen in IUGR, PE, and PIH, points to a shared underlying mechanism of abnormal trophoblast invasion and subsequent placentas insufficiency.[25,26]

The Current study revealed a significant association between diabetes and gross placental morphological abnormalities, a finding that complements previous research focusing on histological changes. A large, retrospective cohort study analyzing 3300 placentas from women with various forms of diabetes (type 1, type 2, and gestational), reported histological changes such as increased placental mass, chronic placental insufficiency, dissociated villous maturation disorders with prevalent immaturity, and varying degrees of involutive-dystrophic and circulatory disorders. While our study examined gross morphology, their detailed histological analysis provides a deeper understanding of the cellular and tissue-level changes associated with diabetes-affected placentas. This concordance between our results and established findings, albeit at different levels of examination, underscores the substantial impact of diabetes on placental structure and function.[27]

Our study revealed a significant difference in gross morphological anomalies of placentas from mothers with thyroid dysfunction, a finding that aligns with the broader understanding that maternal hormonal imbalances can profoundly affect

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placentas structure. As demonstrated in a study which examined 200 placentas, thyroid disorders were associated with notable morphometric and histological changes. They reported differences in placentas shape distribution, with a higher percentage of circular placentas; the mean placentas weight and thickness were lower, while the area and number of cotyledons were higher in the thyroid dysfunction group, mirroring the impact of maternal hormonal changes on placentas size and structure. Their observed lower birth weights in the thyroid dysfunction group; underscore the clinical relevance of these placentas changes.[28] These findings reinforce the critical role of maternal thyroid homeostasis in maintaining healthy placental morphology and function, highlighting the importance of early diagnosis and treatment to prevent adverse fetal outcomes.

A significant difference in gross morphological placentas anomalies among anemic women compared to non-anemic mothers were observed in this study, a finding consistent with research conducted in India demonstrating the impact of anemia on placental outcomes. Specifically, the Indian study investigated various placentas parameters, including weight, volume, diameter, thickness, cotyledon number, infarction, calcification, and umbilical cord characteristics. Similar to current study observations of gross anomalies, they found that anemia significantly affected placentas morphology. Importantly, they also reported a significant decrease in newborn birth weight in anemic women, with the severity of anemia correlating with lower birth weights.[29]

The findings of current study demonstrated a significant association between all types of gross placentas anomalies and adverse pregnancy outcomes; strongly reinforce the established understanding of the placenta's pivotal role. As previously reported, this transient fetal organ is critical for fetal and maternal well-being, sustaining fetal growth through the delivery of oxygen and nutrients and the removal of waste. Consequently, current observation of aligns with the knowledge that defective early placentas development is a primary cause of common pregnancy disorders, including recurrent miscarriage, fetal growth restriction, pre-eclampsia, and stillbirth.[30]

This study is strengthened bya relatively large sample size and a thorough evaluation of both structural and morphological placentas anomalies. Furthermore the established normal ranges for placentas morphological characteristics by utilizing the 5th and 95th percentiles derived from participants with structurally and morphologically typical placentas and no medical disorders, providing a statistically robust basis for abnormality categorization.

However, a limitation arises from the comprehensive approach to identifying all gross anomalies. The lack of comparable published studies examining this breadth of anomalies restricted our ability to fully contextualize and discuss our findings. Furthermore, as a single-center, cross-sectional study, the generalizability and causality of the results are limited. Future prospective research is warranted to validate these observations and elucidate the underlying mechanisms.

Clinical Implications and Future Directions

The findings of this study have significant clinical implications. Antenatal screening for placentas anomalies, particularly in pregnancies complicated by maternal medical conditions, may help identify high-risk pregnancies and facilitate timely interventions. Further research is needed to explore the potential benefits of targeted interventions, such as enhanced fetal monitoring and timely delivery, in pregnancies with placental anomalies. Future studies should also focus on investigating the underlying mechanisms linking placentas anomalies to adverse perinatal outcomes.

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Conclusion

Significant placentas abnormalities are common and strongly correlated with adverse perinatal outcomes, particularly when maternal medical disorders are present. Therefore, placentas assessment is vital for predicting and preventing these outcomes.

Competing interests

The authors declare that they have no competing interests.

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