

Morphological and Histological Changes in Placenta Associated with Anemia - A Review

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ABSTRACT

The Human Placenta is a discoid, deciduate, chorioallantois, haemochorial, and villous organ which maintains pregnancy and promotes normal fetal development. Anemia is the most common nutritional deficiency disorder that affects 25-50% of the population in the world and approximately 50% of pregnant women in the world. Maternal anemia affects placenta's morphological and histological features. Various studies reveal, that the morphological parameters such as placental weight, diameter, thickness, volume, and area were increased whereas number of cotyledons, fetal weight were significantly reduced in anemic placenta as compared to normal. The histological changes reveal a significant increase in the syncytial knot formation, cytotrophoblast proliferation, fibrinoid necrosis, calcification, villous hyalinization, intervillous space and stromal fibrosis. Changes in placental structure has significant implications during the development of the fetus. This review provides an overview of morphological and histological changes of placentae of anemic mothers.

Keywords: Histology, anemia, morphology, placenta

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INTRODUCTION:

Human Placenta is a discoid, deciduate, chorioallantois, haemochorial, and villous organ. It weighs around 500–600 g, usually one-sixth of the fetal weight with thickness of 2.5 cm. Placenta, a vital organ between the mother and the fetus, mediates exchange of gases and nutrients, removes waste products, supports fetal growth and development, protects fetus against infection and harmful substances [1]. Availability of oxygen is a critical factor during the development of placenta and fetus. Iron deficiency anemia during pregnancy may be caused either due to nutritional deficiency or increased demand of oxygen in pregnancy. According to the classification of World Health Organization (WHO), pregnant women with haemoglobin levels < 11.0 g/dl in the first and third trimesters and < 10.5 g/dl in the second trimester are considered anemic [2]. Anemia causes hypoxia, which during pregnancy raises the danger of severe complications such as heart failure, preeclampsia, or heavy bleeding before or after childbirths contributing to 20–40% of maternal deaths [3]. Any pathological condition that affects either the mother or the fetus, disrupts normal placental function, leading to characteristic changes in the morphology and histopathology of the placenta.. This review of

literature critically examines the gross and microscopic changes in placenta of anemic mothers.

Materials and method:

Literature search:

Literature review was done through PubMed, Google Scholar, and other open-access articles. Articles related to Morphology and histological changes associated with maternal anemia were searched online. Keywords such as 'Morphology of Placenta' AND 'anemia', 'Morphometric study of placenta AND anemia', 'Placenta AND anemia', 'Placenta histology AND anemia' were used in the various search engines. The articles were reviewed from 2017 to 2025. The criteria followed for selection of research articles were: (a) Studies on morphometry of placenta in anemic patients (b) Histological studies on placenta of anemic patients (c) Comparative studies between normal and anemic placenta.

Inclusion criteria: Case-control studies-prospective
Exclusion criteria: Studies on any other clinical conditions such as diabetes hypertension, thyroid were excluded.

Method:

After a thorough literature review, 15 articles met our inclusion criteria. Among them, articles related to the comparison of morphological changes in placenta of normal and anemic patients were 4,

articles that compared histological changes in placenta of normal and anemic patients were 4, articles related to morphological changes in anemic placenta were only 3, while 4 compared both histological and morphological changes in normal and anaemic patients.

The articles were selected based on comparisons of morphological and/or histological changes in placentas from anemic versus non-anemic pregnant women, as well as study design, sample size, and maternal age. The morphological parameters assessed in normal and anemic placentae were weight, diameter, area, volume, number of cotyledons, weight of the fetus. The histological parameters such as Syncytial knots, stromal fibrosis, fibrinoid necrosis, Calcification, cytotrophoblast proliferation, villous hyalinisation, intervillous space and villous vascularity were assessed.

Discussion

Maternal anemia is most encountered problems in developing countries. Anemia during pregnancy causes hypoxia, impairing the formation, development, and maturation of the placenta, thereby increasing the risk of both maternal and fetal morbidity and mortality. The components of the placental barrier from maternal to fetal side are:

- Syncytiotrophoblast
- Cytotrophoblast
- Trophoblastic basement membrane
- Extraembryonic mesoderm
- Basement membrane of fetal capillaries
- Endothelium of fetal capillaries.^[15]

As the pregnancy progress, this barrier reduces in thickness.

Significant morphometric and histological changes between anemic and non-anemic placentae have been reported by many authors^[4-14]. Morphological parameters as given in (Table 1) such as placental weight, diameter, thickness, surface area, volume, were significantly increased whereas number of cotyledons and birth weight of the fetus was significantly reduced in anemic placentae as compared to non anemic placentae.^[4-8]

The mean placental weight is possibly increased due to compensatory physiological growth to ensure adequate oxygen supply to the fetus^[16]. The placental thickness which also gives an idea about the size of placenta is increased among anemic group, possibly due to compensatory hypertrophy that tends to increase the thickness as well. The reduction in fetal birth weight is due to hypoxia caused by anemia which impairs the placental development, reducing the surface area for exchange of nutrients and oxygen, thereby hampering fetal growth.^[4] Hypoxic environment also disrupts normal villous branching and septation, which causes reduction in placental septation hence fewer cotyledons^[8]

Parameter	Author	Mean $\pm$ Standard deviation	P value
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Placental weight (gm)		Normal placenta	Anemic placenta	
	Gebre meskel et al. ⁴	502 $\pm$ 93	544 $\pm$ 98	0.03
	Mondal, et al. ⁵	466.6 $\pm$ 20.6	502.16 $\pm$ 50.7	<0.025
	Kavya et al. ⁶	424.00 $\pm$ 69.16	474.53 $\pm$ 70.132	<0.05
	Dr. Nisha Gajbhiye et al. ⁷	425 $\pm$ 69.921	474.63 $\pm$ 70.194	< 0.05
	Aaya Hamid Hamad Hassan AL-Hakeem et al. ⁸	504.772	578.913	0.928
Placental diameter (cm)	Gebre meskel et al. ⁴	17 $\pm$ 1.5 cm	18 $\pm$ 1.5 cm	0.002
	Mondal, et al. ⁵	18.56 $\pm$ 1.7	19.38 $\pm$ 1.1	-
	Kavya et al. ⁶	17.032 $\pm$ 1.81	18.303 $\pm$ 2.02	<0.05
	Dr. Nisha Gajbhiye et al. ⁷	17.050 $\pm$ 1.8174	18.306 $\pm$ 2.0378	< 0.05
	Aaya Hamid Hamad Hassan AL-Hakeem et al. ⁸	16.266	16.798	0.379
Placental thickness (mm)	Gebre meskel et al. ⁴	20 $\pm$ 0.6	22.7 $\pm$ 2.4	0.001
	Mondal, et al. ⁵	17.9 $\pm$ 1.0	19.0 $\pm$ 2.0	-
	Kavya et al. ⁶	21.30 $\pm$ 2.89	24.10 $\pm$ 5.70	<0.05
	Dr. Nisha Gajbhiye et al. ⁷	21.60 $\pm$ 2.989	24.11 $\pm$ 5.715	< 0.05

	Aaya Hamid Hamad Hassan AL-Hakeem et al. ⁸	24.272	28.204	0.410
Placental volume (ml)	Mondal, et al. ⁵	398.8±14.1	446.0±67.1	0.000689
	Kavya et al. ⁶	352.31±58.120	393.13±63.632	<0.05
	Dr. Nisha Gajbhiye et al. ⁷	352.5±8.881	393.23±63.674	<0.05
Number of cotyledons	Gebremeskel et al. ⁴	17.6 ± 1.1	13.5 ± 1.8	<0.001
	Mondal, et al. ⁵	17.46±0.1	12.90±1.9	-
	Kavya et al. ⁶	16.00±2.310	13.23±3.104	<0.05
	Dr. Nisha Gajbhiye et al. ⁷	16.00±2.357	13.24±3.107	<0.05
	Aaya Hamid Hamad Hassan AL-Hakeem et al. ⁸	22.428	22.86	0.401
Birth weight of fetus (gm)	Gebremeskel et al. ⁴	3035 ± 305	2562±360	<0.001
	Mondal, et al. ⁵	2580±290	2180±300	<0.001
	Dr. Nisha Gajbhiye et al. ⁷	2727±294.7	2406±423.7	<0.05
Placental average area (cm²)	Mondal, et al. ⁵	266.03±22.4	294.71±27.5	4.56328E-05

TABLE 2: Histological changes in placenta of anaemic mother

Histological findings	Authors	Effect on Placenta of anaemic mothers
Syncytial knots	Khan AZ et al. ⁹ Mridul Tripathi et al. ¹⁰ Gebremeskel T et al. ¹¹ Sukhjinder Kaur et al. ¹² Shobharani MS. ¹³ Mondel et al. ¹⁴	Increased
Calcification	Khan AZ et al. ⁹ Mridul Tripathi et al. ¹⁰ Gebremeskel T et al. ¹¹ Sukhjinder Kaur et al. ¹²	Increased
Fibrinoid necrosis	Khan AZ et al. ⁹ Mridul Tripathi et al. ¹⁰ Sukhjinder Kaur et al. ¹² Shobharani MS. ¹³ Mondel et al. ¹⁴	Increased
Cytotrophoblastic proliferation	Khan AZ et al. ⁹ Mridul Tripathi et al. ¹⁰ Gebremeskel T et al. ¹¹	Increased

	Mondel et.al ¹⁴	
Villous hyalinisation	Mridul Tripathi et.al ¹⁰ Sukhjinder Kaur et al. ¹² Shobharani MS. ¹³	Increased
Stromal fibrosis	Mridul Tripathi et.al ¹⁰ Sukhjinder Kaur et al. ¹² Shobharani MS. ¹³	Increased
Villous vascularity	Gebremeskel T et.al ¹¹ Shobharani MS. ¹³ Mondel et.al ¹⁴	Increased

The histological features of anemic placenta such as Syncytial knots, stromal fibrosis, fibrinoid necrosis, calcification, cytotrophoblast proliferation, villous hyalinisation, intervillous space and villous vascularity were significantly increased (**Table 2**)^[9-14].

Syncytial knots- localized swelling or aggregation of syncytio trophoblastic nuclei in the villi of the placenta during early pregnancy. Increased syncytial knots in anemic placentae suggest that new villi were attempted to increase an effective surface area for exchange^[17]. Increased cytotrophoblast proliferation are ischemic changes that take place in the placenta due to low oxygen tension caused in maternal anemia^[11]. Fibrinoid necrosis is seen as a nodular mass of homogenous acidophilic material in the villi. It is considered as a hallmark of immunological reactions within the trophoblastic tissue^[10]. Hypoxia in anemia, leads to stromal fibrosis which thicken the stromal core thus reducing the diffusion efficiency between maternal and fetal blood^[8].

Conclusion:

The placenta maintains a vital connection between the mother and the fetus, and placental studies therefore hold great clinical importance. Maternal anemia produces significant morphological and histological alterations in the placenta, which can adversely affect fetal growth and pregnancy

outcomes. The associated hypoxia leads to changes such as increased placental weight, thickness, and congestion of septal capillaries, all of which may contribute to low birth weight and preterm delivery. Early detection and proper management of anemia are therefore essential to ensure optimal placental function and healthy fetal development. Routine postpartum gross and microscopic examination of the placenta should be encouraged, as it provides valuable diagnostic insights that support better clinical decision-making. In developing countries, iron supplementations are definitely recommended during pregnancy along with educating women as it will help them make better health and nutrition choices during pregnancy which will improve the maternal and fetal health

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