Assessment of Changes in Macroscopic Components of Placenta in Maternal Anemia

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Abstract:
Background: Maternal anemia causes macroscopic changes in human placenta which may lead to adverse pregnancy outcome. So, the present study was planned to observe the effect of maternal anemia in macroscopic components of placenta. **Methods:** This cross sectional, analytical type of study was carried out on 100 placenta collected from the Department of Gynecology and Obstetrics, Rangpur Medical College and Hospital, Rangpur just after delivery. Among them 62 placentas were collected from anemic mother and 38 placentas were collected from healthy pregnant mothers. Among 62 anemic placentas, 20 were from mild anemic mothers, 38 were from moderate anemic mothers and 4 from severe anemic mothers. Volume of each placenta was measured by water displacement method. The percentage of the total volume of placenta occupied by parenchyma and non-parenchyma were counted by using the macroscopic point-counting techniques and absolute volume was calculated from total volume of placenta. Any macroscopic pathology in these placentas was also noted. **Results:** Though statistically significant difference was found between proportional volume of parenchyma and non-parenchyma between the four groups by one way ANOVA test (p=0.000), but the difference was significant only in absolute volume of non-parenchyma between groups. Infarction, calcification and hemorrhage affected anemic placenta more commonly than control group. **Conclusion:** From this study it may be concluded that proportional volume of parenchyma of placenta in moderate anemia of mother was increased may be due to support the fetal growth.

Indexing words: Parenchyma, Non-parenchyma, pathological component, Maternal anemia

Introduction:

Anemia is a very common hematological problem and creates an important risk factor in pregnancy in developing and underdeveloped countries.[1] The placenta is essential for maintaining pregnancy and promoting normal fetal development. This foetomaternal organ comprises of a fetal portion the chorionic plate and a maternal portion the decidual plate separated by a lacunar space the intervillous space.[2] Placenta, a documentation of events of gestational life, may have a causal relationship to abnormal fetal outcome.[3] So, by examining the changes of in placental component, one could easily identify any deviation of fetomaternal outcome from normal. So, the present study was aimed at to find out the changes in the macroscopic components of the human placenta in maternal anemia.

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Methods:

This cross sectional, analytical type of study was carried out on 100 placenta (anemic and control) between the period of July 2015 to June 2016. The placentas were collected from the Department of Gy+
necology and Obstetrics, Rangpur Medical College and Hospital, Rangpur just after delivery. Among the 100 placentas, 62 placentas were collected from anemic mother, 38 placentas were collected from healthy pregnant mothers.

Among 62 anemic placentas, 20 were from mild anemic mothers, 38 were from moderate anemic mothers and 4 from severe anemic mothers. Grading of anemia was done according to WHO.[4] Just after collection, each specimen was gently washed in tap water on a dissection tray; the film of blood and blood clots on the maternal surface were removed with hand gently, without disturbing any firm clot which were embedded in the substance of placenta. The umbilical cord was cut 2 cm away from disc margin. The amniotic membrane was trimmed at disc margin with a scissors. Then the placenta was mopped and dried with dry cotton pad and blotting papers very gently. Volume of the placenta was measured in milliliters (ml), by water replacement method using Archimedes principle. At first the placenta was immersed in a wide jar filled with water. After wards, the total amount of water displaced from the jar was collected and measured in 1000 cc graduated cylinder. This volume in milliliter represented the volume of the placenta. Then the placenta was placed in a 10% formalin filled plastic jar with cover for at least 7 days with appropriate tag. After fixation, proportions of parenchyma to non-parenchyma and presence and area occupied by calcification, infarction and hemorrhage were noted.

The placental tissue can be described as a sum of parenchymal, non-parenchymal and pathological components. The parenchyma comprised of chorionic villi with their fetal vessels and the maternal intervillous space and non-parenchyma consists of chorionic and decidual plates, fetal vessels of diameter >0.1 cm and intercotyledonary septa along with the pathological components e.g. old and recent infarcts, calcification and subchorionic fibrin.[5] Placental infarction is a zone of ischemic necrosis of a group of villi due to complete interference with their blood supply in the decidua or by thrombosis of a spiral arteriole or a retroplacental hemorrhage. Placental infarcts, when fresh, are demarcated, dark red and moderately firm; as they age they become converted into hard, white structure less plaques. Morphologically calcium deposits are seen as white or pale color fine granules or clumps often felt as gritty deposits.[6] A hematoma is formed by blood insinuating itself between the cotyledons of placenta proper. If the placenta is delivered soon after the hemorrhage has occurred it shows a depression on the maternal surface with firmly attached blood clot. These pathological components were included in the non-parenchyma in the present study.[7]

In the present study, the percentage of the total volume occupied by parenchyma and nonparenchyma were calculated by using the macroscopic point-counting technique.[5] The principle depends on the facts that in a composite organ, the volume of the components are equivalent numerically to the relative areas occupied by these components on cut surface. If a grid (as shown in Figure1) of regularly spaced points are placed over the cut surfaces, the number of points over these components would be proportional to their area, hence to their volume.

For this purpose, each formalin-fixed placenta was placed flat on a tray on fetal surface and cut into 10 to 15 slices with a sharp knife (Fig 2a). Each slice was 1 cm thick, containing 4 surfaces one maternal, one fetal and two internal surfaces. The internal surfaces placed flat and carefully examined for any unusual thickness and color change. A grid composed of points spaced 0.5 cm apart printed on transparent plastic material, was placed on the internal surface of each of the fixed slices of placenta. The position of each point, whether lying over parenchyma or non-parenchyma, was recorded.

For each of the placenta, the positions of about 1000 points were recorded. From the 1000 points, the percentage of the points falling on the parenchyma or non-parenchyma was calculated. These percentages represented the proportional volume of individual components. Absolute volume of the parenchyma and non-parenchyma were calculated from the total volume of the placenta measured by water displacement method. Percentage of pathological components like infarction, calcification and hemorrhage were noted (Fig. 2b and 3).

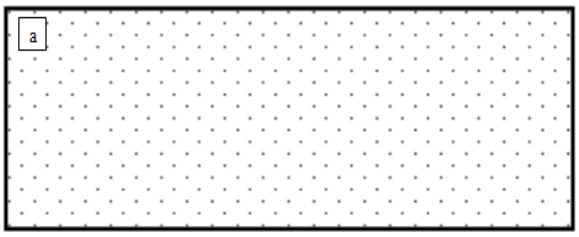


Fig 1: Photographs showing transparent grid indexed with points at 0.5 cm intervals.



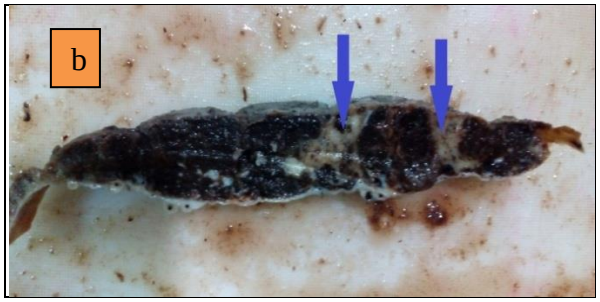


Fig 2 Photograph showing(a) cut pieces of placenta and(b) infarction

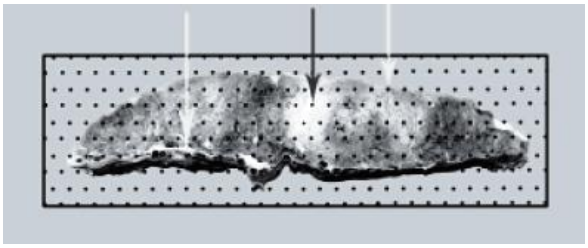


Fig 3. Photograph showing cut pieces of placental calcification.

Results:

The mean (± SD) of volume of the placenta was 406.61 ± 59.50 ml in control group and were 396.10 ± 61.15 ml, 385.53±76.22 ml, and 349±115.54 ml in mild, moderate and severe anemic groups respectively. Though the placental volume was lower in anemic groups than control group with ascending grades of anemia and the lowest value was found in severe anemic group but these differences did not reach significant level. The mean ± SD of proportional volume of the parenchyma of the placenta was 74.56 ± 5.94% in control group and 69.76 ± 11.89%, 80.35 ± 3.92% and 75.30 ± 18.05% in mild, moderate and severe anemic groups respectively (Table 1). It was observed that the proportional volume of parenchyma was reduced in mild anemic group but increased than control in moderate anemic group and again reduced in severe anemic group to be similar value like control group. The mean ± SD of proportional volume of the non-parenchyma of the placenta in control group was 24.13 ± 5.99% and were 29.97 ± 12.06%, 19.52 ± 4.30% and 24.03 ±18.71% in mild, moderate and severe anemic groups respectively (Table 1). It could be stated that the proportional volume of non-parenchyma was increased in mild anemic group but reduced in moderate anemic group than control group. However the severe anemic group showed similar value of proportional volume of non-parenchyma than control. Statistically the difference in proportional volumes of parenchyma and non-parenchyma between the four groups was highly significant (p=0.000).

Table 1: Proportional volume of parenchyma and non-parenchyma of placenta in control and anemic groups

Volume of placental macroscopic components	Control group (n=38)	Anemic group (n=62)			p value
		Mild n=20	Moderate n=38	Severe n=4	
Parenchyma:	53.8-92.4	34.5-83.5	68-88.80	48.9-88.9	0.000
Proportional (%)	74.56 ±5.94	69.76±11.89	80.35±3.92	75.3±18.05	(S)
Non-parenchyma:	6.5–45.2	16.50-65.40	9.7-32	8.6 – 51.1	0.000
Proportional (%)	24.13± 5.99	29.97±12.06	19.52±4.30	24.07±18.71	(S)

Results are shown as range and mean ± SD
p values reached from ANOVA test
S: significant at 95% confidence level
NS: non-significant.

In control group, the mean ± SD of absolute volume of the parenchyma of the placenta was 303.02 ± 52.15 and were 273.67 ± 46.51 ml, 309.22 ± 60.68 and 279.62 ±.102.75 ml in mild, moderate and severe anemic groups respectively. The absolute volume of the parenchyma in the mild and severe anemic group were lower than that in the control group but in moderate anemia it was slightly higher than control group. However, the differences between the four groups were statistically not significant. The mean ± SD of absolute volume of non-parenchyma were 103.58 ± 28.07 ml in control group and were 122.42 ± 56.17, 76.30 ± 23.17 and 100.38 ± 81.87 ml in mild, moderate and severe anemic groups respectively. It was observed that the absolute volume of non-parenchyma was increased in mild anemic group but reduced in moderate and severe anemic group than control group. These differences between groups were statistically significant (p=0.000).

Table 2: Absolute volume of parenchyma and non-parenchyma of placenta in control and anemic groups

Volume of placental macroscopic components	Control group (n=38)	Anemic group (n=62)			p value
		Mild n=20	Moderate n=38	Severe n=4	
Parenchyma:	209.82-425.04	120.75-308	136.51-422.28	177.80–379.80	0.131
Absolute (ml)	303.02 ±52.15	273.68± 46.51	309.22±60.68	279.62±102.75	(NS)
Non-parenchyma:	34.97-180.18	51.15-237.39	28-150.40	22.2 – 214.62	0.000
Absolute (ml)	103.58±28.07	122.42±56.17	76.30 ± 23.17	100.38±81.87	(S)

Results are shown as range and mean ± SD
p values reached from ANOVA test
S: significant at 95% confidence level
NS: non-significant.

Percentages of macroscopic pathological components:

Different types of placental pathology were observed during macroscopic point counting examination. These were infarction, calcification and hemorrhage. These pathologies were present in a variable percentage in the placenta of control group but more frequently in the placenta of the different anemic groups (Table 3).

Infarction was present in 29 (out of 38) and 18 (out of 20) placenta in control and mild anemic groups respectively but all 38 placenta of moderate anemic group and 4 placenta of severe anemic group was affected by this pathology. Volume proportion of area of placenta occupied by this pathology was only 4.31% areas of total volume in control group but area occupied by this pathology was 2.11%, 9.65% and 10.2% in mild, moderate and severe anemic groups respectively**.** So it could be stated that the presence of infarction was increased in a variable proportion in the moderate and severe anemic groups but reduced in mild anemic groups than control group. The differences between the four groups were statistically not significant.

Regarding calcification, though it was present in four groups, in control group presence of calcification was seen in 35 (out of 38) cases and all placenta of different anemic groups. Volume proportions of area of placenta occupied by this pathology was only 8.23% of total volume in control group but were 11.6%, 17.08% and 21.5% in mild, moderate and severe anemic groups respectively**.** The difference was statistically not significant between the four groups.

Regarding hemorrhage, it was present in 3 placenta of severe anemic group and occupies 7% area of total proportional volume but hemorrhage was not found in control, mild and moderate anemic groups.

Table 3: Proportional volume of different macroscopic pathological components in control and anemic group

Pathological components	Control group (n=38)	Anemic group(n=62)		
		Mild (n=20)	Moderate (n=38)	Severe (n=4)
Infraction (%)	29(4.31%)	18(2.11%)	38 (9.65%)	4(10.2%)
Calcification (%)	35(8.23%)	20 (11.6%)	38(17.08%)	4(21.5%)
Hemorrhage (%)	No case	No case	No case	3(7%)

Results are shown as number cases affected
Values in parenthesis indicates the percentages of areas occupied by these pathologies

Discussion:

The present study shows increase proportional volume of parenchyma in moderate anemic group than normal but lower value than normal was found in severe and mild anemic group. Proportional volume of parenchyma was increased in expense of non-parenchyma in moderate anaemic group than control but opposite was true in mild anemia. Though the absolute volume of parenchyma was reduced in mild and severe anemic groups and increased in moderate anemic group than control, the differences between the four groups by ANOVA were statistically not significant. It could be explained that though the proportional volume of parenchyma was decreased in mild anemic group and increased in moderate anemic group than control, but as the total volume of placenta was decreased in anemic groups than control, did not reached a significant level for these variables in terms of absolute volumes. This study is similar to findings of study Singla et al.[8]

One study showed parenchyma was altered disproportionately with volume of placenta in maternal anemia. Findings are similar to present study.[5] In one study, Huang et al showed volume proportion of parenchyma in term of villi and intervillous space was significantly increased in maternal anemia.[9] Present study also reflects proportional volume of parenchyma is increased in moderate anemia. In one study Huang et al described the volume of intervillous space increased in maternal hypoxia.[7]

In control group of present study, infarction was present in 29 (76.31%) cases and the extent of infarction was less than 5% of placental tissue. However, all placentas out of anemic group except 2 placentas of mild anemia were affected by infarction; among them the extent of infarction was more than 5% of placental tissue. Placental infarct was found to be significantly more at decreasing concentration of hemoglobin in present study. Similar findings were found by other studies.[9-13] They all suggested that increase in infracted area decreases functional villous mass. When the infarcts were located away from the placental margins, and particularly when they were haphazardly distributed, conditions of malperfusion always exist. Infarcts in any location in first and second trimester placenta are always abnormal. Placental infarcts that make up more than 5% placental mass are considered pathologic and may influence the fetal oxygen/nutrition state.[12] In moderate and severe anemia same findings are also true in case of present study. It was found extensive areas of infarction, characterized by villous crowding and increased number of hypovascular villi in anemic placentae by Biswas et al.[14]

Infarction was more in small for gestational age babies as compared to normal group.[15] One study stated that the placenta can withstand the loss of nearly a third of its functional parenchyma without any fetal embarrassment bears eloquent witness to the fact that, it has very considerable functional reserve capacity.[16]

Calcification is common in human placenta and recognized as a normal part of maturation and is thought to represent a physiological aging process of this organ. It is not only an aging process, but also a reflection of underlying placental dysfunction when it occurs in earlier stages of pregnancy. Possible mechanisms of tissue calcification involve physiological, dystrophic and metastatic.[17] Again in a study Fox stated that, it was categorized as severe when it occupies 25% area of the surface of placenta in naked eye and associated with calcified patches.[16] In present study it is not similar as in anemic placenta calcification occupying less than 25 % surface area.

In present study in control group calcification was seen in 35 (92.10%) cases and the extent of calcification was less than 10% of placental tissue on gross macroscopic examination. However, placental calcification was seen in all cases of anemic groups except 2 placentas in mild anemic group. Infraction and calcification were significantly more in anemic group. However, Rohini et al stated calcification was found more frequently in anemic placenta (63.33%/26.66%).[13] There was significant increase in calcification in placenta of anemic groups in comparison to control group.[18]

One study stated that placental calcification, often thought as a hallmark of degeneration or

senescence, is of no clinical or pathological significance.[15]

Conclusion:

From this study it may be concluded that maternal anemia may affect the macroscopic components of placenta and the pathological components affect these placentas in a higher proportion than healthy control group.

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