

Postnatal Morphometric Study of Placenta in Normal and Anaemic Pregnancy

SB Parate¹, JV Deshpande², MP Parchand³, DK Chopade⁴

ABSTRACT

Introduction: The placenta is a materno-fetal organ which begins developing at implantation of the blastocyst and is delivered with the fetus at birth. Aim of this study was to search for any correlation between the features of placenta in anaemic pregnancy, depending on the status of the mother in terms of haemoglobin level.

Material and Method: This study consist of control (non-anaemic) and study (anaemic) groups were compared for same parameters attempt correlation between grading of anaemia with placental abnormalities. 280 placentae were collected after the normal delivery or caesarian section of women. This study group included 140 cases. This requires haematological examination which includes estimation of 1) Haemoglobin 2) Total Red Blood cell count (in severe anaemia) and 3) Peripheral blood smear. Normal pregnancies as control group included 140 cases. After examination of placenta, placental weight, surface area and volume in different grades of anaemia compared with control by ANOVA Test i.e. Analysis of Variance. Multiple comparisons done by Bonferroni's test.

Results: In the present study, 1) In CONTROL group the mean placental weight is found to be 409.64 ± 52.39 gm and in study group measured as 482.43 ± 111.04 gm. 2) The mean surface area of the placenta in control group and in study group were recorded as 226.20 ± 44.88 sq. cm and 260.08 ± 63.11 sq. cm respectively. 3) While the mean placental volume in the CONTROL and STUDY group were 479.46 ± 96.20 cu.cm and 566.89 ± 136.91 cu.cm respectively.

Conclusion: Thus, it is observed that there is significant increase in all parameters in the study group than that of the control group and it increases as per severity of anaemia. So we concluded that anaemia and iron deficiency during pregnancy are associated with increased placental weight.

Key Words: Placental Study, Morphometry of Placenta, Pregnancy Anaemia

uterine status of the foetus.

Anaemia is a condition in which the number of red blood cells (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs. During pregnancy there is a disproportionate increase in plasma volume, RBC volume and haemoglobin mass. As plasma volume increase more than the RBC mass haemodilution occurs (maximum around 32 weeks) resulting in physiological anaemia of pregnancy. Pregnancy induced anaemia, is anaemia that develops during pregnancy due to various factors associated with the physiology of pregnancy. For this reason, haemoglobin level below 10 gm/dl at any time during pregnancy is considered as anaemia in developing countries [WHO and US Center for Disease Control (CDC)]. Hemoglobin level at or below 9gm/dl requires detail investigations and appropriate treatment.³

Anaemia is a widely prevalent condition in India, especially in women of childbearing age. Surveys carried out in different parts of India indicate that, more than 50% women have nutritional anaemia in later months of pregnancy.⁴ Cause of anaemia includes the nutritional deficiency, acute and chronic inflammation, parasitic infestation and inherited or acquired disorders that affect haemoglobin synthesis, red blood cell production or red blood cell survival can cause anaemia. The World Health Organization (WHO) has estimated that prevalence of anaemia in pregnant women is 14 per cent in developed and 51 per cent in developing countries and 65-75 percent in India.⁵ In India, National Family Health Survey-2 in 1998 to 99 shows that 54% of women in rural and 46% women in urban areas are anaemic.⁶

According to WHO, haemoglobin level below 11 gm/dl in pregnant women constitutes anaemia and haemoglobin below 7gm/dl is severe anaemia. The Center for Disease Control and Prevention (1990) defines anaemia as less than 11gm/dl in the first and third trimester and less than 10.5gm/dl in second trimester.^{7,8} The relative prevalence of mild, moderate and severe anaemia are 13%, 57% and 12% respectively in India (ICMR data).

Among them iron deficiency anaemia (IDA) is commonest

INTRODUCTION

It is a vital organ for maintaining pregnancy and for promoting normal foetal development. It is the only organ in the body which is derived from two separate individuals. It grows with the baby from the very first cell divisions, so it has a huge role to play throughout the pregnancy acting as the kidneys, lungs and intestine all in one.¹ The word 'Placenta', comes from the Latin word for cake and Greek word 'Plakuois' meaning 'Flat cake' was coined for the first time by 'Realdus Columbus' in 1559.² As per the meaning of the word, it is circular, discoid organ, the growth of which is directly influenced by the maternal health conditions and accordingly it affects the intra-

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type of anaemia in pregnancy.⁹ Pregnancy outcome depends on placental morphology. Therefore it is our humble attempt to compare the placentae of normal and anaemic pregnancies and also correlate the changes in placenta according to severity of anaemia.

MATERIAL AND METHOD

The material consisted of 280 placenta collected from the labour room and operation theatre of the department of Obstetrics and Gynaecology, Govt. Medical College and Hospital Nagpur, India, over the period of two years.

All placentae were included in the study, all from the full term deliveries (38-42 weeks of gestation).

All cases were divided into two main groups.

Control group: Non anaemic pregnant cases were taken as control group and their respective.

placentae. This group included 140 cases.

Study group : Anaemic pregnancies which were diagnosed as nutritional anaemia (iron deficiency anaemia most common). This group included 140 cases. This requires haematological examination which includes estimation of: Haemoglobin, Total red blood cell count (in severe anaemia) and Peripheral blood smear.

Arbitrary grading of anaemia was done according to the level of haemoglobin. Dutta D.C.¹⁰

- 1) Severe : less than 7 gm/dl
- 2) Moderate : less than 8 to 7 gm/dl
- 3) Mild : between 8 to 10 gm/dl

Inclusion criteria for the control Group: The cases with hemoglobin level of 10 gm/dl or above at delivery and preferably throughout the pregnancy. Therefore it was taken as the sole criterion for inclusion in the control series.

Inclusion criteria for the study Group: The cases having hemoglobin level below 10gm /dl, one or more occasions before delivery. The study group included both booked and non-booked patients who presented for the first time in labour and also patients in whom anaemia had been detected and treated early in pregnancy.

Exclusion criteria for both study and control group

1. Patients with ante partum hemorrhage
2. Multiple pregnancy
3. Preterm delivery
4. Toxaemia of pregnancy

Instruments used for the study: Weighing machine for weighing placenta, Forceps to remove the membranes, White enamel tray, Magnifying lens, Measuring scale for measuring the diameter of placenta and Vernier caliper for measuring the thickness of placenta

METHOD

The placentae with cord and membranes were collected immediately after delivery from the labour rooms or an operation theatre. Abnormalities of the cord and membrane were noted. In all the cases, the amnion and chorion were trimmed from the placenta. The umbilical cord was cut at a distance of 5 cm from the site of insertion. Foetal blood were allowed to drain

out from the cord and adherent blood clots were removed from maternal surface of placenta.

Then, the placentae were washed in running tap water, dried with the help of blotting paper weighed in the weighing machine. The weights of the placentae were noted in grams.

For calculating surface area of the placenta, diameter of the placenta was measured by taking as average of the diameter in three various plane with the measuring scale. Thickness of placenta for calculation of volume was measured at the center of the placenta.

Surface area of the placenta = πr^2 , where π - 3.14, r- Radius of the placenta.

Central thickness of the placenta was measured with the Vernier Caliper, and volume of placenta was calculated.

Volume of placenta = $\pi r^2 h$, where π - 3.14, r- Radius of the placenta, h- Thickness of the placenta

The maternal surface of the placenta was observed by placing the placenta on the dorsum of the hand and whether any abnormality in the form of infarction and fibrosis were examined on the both surfaces by magnifying lens. Then the attachment of the umbilical cord to the foetal surface was noted, whether it is central or marginal. Also both surfaces were examined for presence of foci of infarction. All these values were noted in the control group as well as in the study group and the comparison between the two groups was done.

STATISTICAL ANALYSIS

Continuous variables were presented as mean \pm standard deviation. Categorical variables were expressed in percentages. Placental weight, surface area and volume of placenta in different grades of anaemia compared with control by ANOVA Test i.e. Analysis of Variance. Multiple comparisons done by Bonferroni's test. Categorical data was analysed by chi square statistics. $P < 0.05$ was considered as statistical significance. Data was analysed on statistical software STATA version 10.0.

RESULT

The present study was carried out with a view to study the placental changes in pregnancy anaemia and to compare various parameters of the placenta and the maternal profile.

The cases were divided into two groups-

Control group: Non-anaemic pregnant patients and respective placentae (n=140).

Study group: Pregnant cases diagnosed as nutritional anaemia, and respective placentae (n=140) (Table 1).

From the above table, it is clear that out of 140 patients of nutritional anaemia, 95 patients (i.e., 67.86%) have mild anaemia, 26 patients (i.e., 18.57%) have moderate anaemia and 19 patients (i.e., 13.57%) have severe anaemia. The mean haemoglobin level for the control group is 10.81 ± 0.43 gm/dl and study group is 8.06 ± 0.99 gm/dl. The difference is found to be highly significant in between two groups ($p < 0.001$) (Table 2). Above table shows that mean placental weight in control and study group 409.64 ± 52.39 , 482.43 ± 111.04 respectively. Out of the 140 cases of anaemic pregnancies, 11 cases were de-

Groups	Haemoglobin level gm/dl	Number of patients
Control	More than 10	140
Study		
Mild Anaemic	Between 8 to 10	95(67.86%)
Moderate Anaemic	7 to less than 8	26(18.57%)
Severe Anaemic	Less than 7	19(13.57%)
Table-1: Number of patients studied according to haemoglobin level (gm/dl) in two groups		

	Control Group (n= 140)	Study Group (n = 140)	p value
Mean placental weight in gm	409.64 ± 52.39	482.43 ± 111.04	p = 0.0000, *HS
Mean placental area in sq. cm	226.20 ± 44.88	260.08 ± 63.11	p = 0.0000, * HS
Mean placental volume in cu. cm	479.46 ± 96.20	566.89 ± 136.91	p = 0.0000, * HS
*HS – Highly Significant (p <0.001)			
Table-2: Placental Morphometric study			

livered as stillbirths. It is noted that in anaemic pregnancies, mean placental weight in the two groups differs and the difference is highly significant (p=0.0000). The mean placental surface area in control group and study group are found to be 226.20 ± 44.88 and 260.08 ± 63.11 respectively and difference is highly significant (p=0.0000). Similarly, the mean placental volume in control and study group are 479.46 ± 96.20 and 566.89 ± 136.91 respectively and the difference is highly significant (p=0.0000).

Thus, the above data suggest that there is increase in mean placental weight, mean surface area and mean volume of the placenta in anaemic group as compared with control group and the difference is statistically significant (Table 3).

ANOVA test is applied. Analysis is made between mean placental weight in mild, moderate and severe anaemic patients with non anaemic patients (control group) and mean placental weight values presented. The difference found to be highly significant (p=0.0000). Correlation coefficient shows negative correlation in haemoglobin level and weight of placenta (r=-0.2556) and it is statistically significant (p=0.0023, significant p<0.05) (Table 4).

ANOVA test is applied. Analysis is made between mean placental surface area in mild, moderate and severe anaemic patients with non-anaemic patients (control group) and mean placental surface area. The difference found to be highly significant (p=0.0000). There was negative correlation in haemoglobin level and placental surface area (r=-0.2143) and it found to be statistically significant (p=0.0110, significant p<0.05) (Table 5).

ANOVA is applied. Analysis is made between volume of placenta in mild, moderate and severe anemic patients with non anaemic patients (control group) and mean placental volumes. The difference found to be highly significant (p<0.001). Correlation coefficient shows negative correlation in haemoglobin level and volume of placenta (r= -0.2235) and it is statistically significant (p=0.0079, significant p<0.05).

Haemoglobin (gm/dl)	Number of patients	Mean placental weight (gm)
Severe-anaemic (<7)	19	553.16 ± 193.36
Moderate-anaemic (7-<8)	26	535.6 ± 110.76
Mild-anaemic (8-10)	95	456.21 ± 71.61
Non-anaemic (>10)	140	409.64 ± 52.39
ANOVA, F = 28.40, p = 0.0000 *HS		
Multiple comparison by Bonferroni test.		
Severe Vs Non-anaemic	P = 0.0000 *HS	
Moderate Vs Non-anaemic	P = 0.0000 *HS	
Mild Vs Non-anaemic	P = 0.0000 *HS	
Correlation coefficient, r = - 0.2556, p = 0.0023 **S		
*HS- highly significant (p<0.001); *S- Significant (p<0.05)		
Table-3: Placental weight in gram according to Haemoglobin level in gm/dl		

Haemoglobin (gm/dl)	Number of patients	Mean placental area in sq. cm
Severe-anaemic (<7)	19	295.61 ± 104.82
Moderate-anaemic (7- <8)	26	283.90 ± 60.63
Mild-anaemic (8-10)	95	248.00 ± 46.17
Non-anaemic (>10)	140	226.20 ± 44.88
ANOVA, F = 14.81, p = 0.0000 *HS		
Multiple comparison by Bonferroni test.		
Severe Vs Non-anaemic	p = 0.0000 *HS	
Moderate Vs Non-anaemic	p = 0.0000 *HS	
Mild Vs Non-anaemic	P = 0.014 *S	
Correlation coefficient, r = - 0.2143, p = 0.0110 *S		
*HS- highly significant (p<0.001); *S- significant (p<0.05)		
Table-4: Surface area of placenta in sq.cm according to Haemoglobin level in gm/dl		

Haemoglobin (gm/dl)	Number of patients	Volume of placenta cu.cm.
Severe-anaemic (<7)	19	638.26 ± 229.36
Moderate-anaemic (7-<8)	26	617.39 ± 146.11
Mild-anaemic (8-10)	95	541.91 ± 95.97
Non-anaemic (>10)	140	479.46 ± 96.20
ANOVA, F = 18.91, p = 0.0000 *HS		
Multiple comparison by Bonferroni test		
Severe Vs Non-anaemic	p = 0.0000 *HS	
Moderate Vs Non-anaemic	p = 0.0000 *HS	
Mild Vs Non-anaemic	p = 0.0000 *HS	
Correlation coefficient, r = - 0.2235, p = 0.0079 **S		
*HS- Highly Significant(p<0.001); **S- Significant (p<0.05)		
Table-5: Volume of placenta in cu. cm according to Haemoglobin level in gm/dl		

DISCUSSION

Study group consist of anaemic pregnancy having nutritional deficiency anaemia. In this study, an attempt has been made to discuss the various parameters of placenta comparing in control and study group.

1. Placental weight

Adair and Theelander¹¹ found average weight of normal term

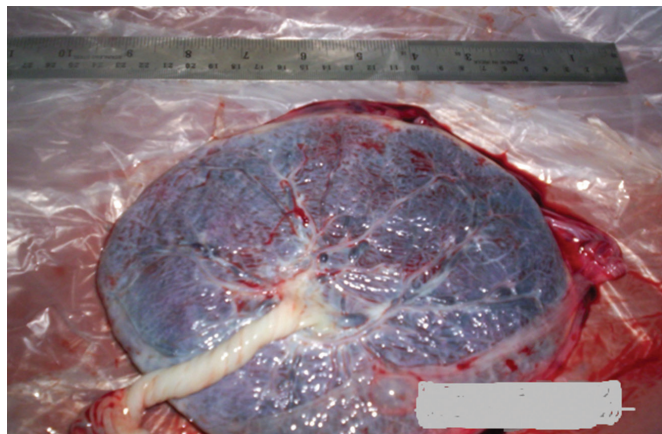


Figure-1: Full term placenta of non-anaemic mother with membranes and cord showing foetal surface



Figure-2: Full term placenta of anaemic mother weighing 700 gm

placenta as 473 gm, Little W. A.¹² recorded it as 448 ± 93 gm. Armitage et al.¹³ reported the weight of placenta to be 508 gm. Kishwara et al.,¹⁴ in their study from Bangladesh mentioned that the placental weight in normal group ranged from 250-560 gm with mean placental weight 406.90 gm and SD 72.64 gm. In the present study, in CONTROL group the mean placental weight is found to be 409.64 ± 52.39 gm and in study group measured as 482.43 ± 111.04 gm. But our finding are not in agreement with the finding of Dhall U.,¹⁵ found placental weight 454.01 ± 90.93 gm in control group and 436.81 ± 88.12 gm in anaemic group. Singla et al.¹⁶ recorded mean placental weight of normal term pregnancy as 402 ± 81 gm as compared to 69 anaemic mothers with haemoglobin concentration ranging from <6 gm to 11 gm/dl reported that placental weight was lower in anaemic mothers so that, the finding of present study is not similar to this study. But Beischer et al.¹⁷ measured the average placental weight in non anaemic Indian women as 476 gm and in 199 placentae from anaemic Indian women was found to be 521 gm. Agboola A.¹⁸ noticed the mean placental weight of normal term placenta as 507.5 ± 75.6 gm and in 25 anaemic placentae recorded it as 563.0 ± 102.5 gm. Lao T.T. & Wong W.M.¹⁹ have done retrospective study in 232 mothers with iron deficiency anaemia and 279 non anaemic mothers as controls. The iron deficiency group had higher placental weight ($p=0.001$). Simi-

lar observation at high altitudes by Kruger & Arias- Stella²⁰ suggested that placental hypoxia was possibly responsible for this hypertrophy. A similar trend has found in present study as per above authors. The possible explanation can be hypoxia due to anemia and compensatory increase in blood flow which leads to increase in placental weight.

2. Placental Surface Area

The surface area of the placenta explains the efficacy of the placenta to transfer the amount of nutrients, oxygen and carbon-di-oxide that passes from the mother to fetus. Placental surface area growth is completed by third trimester, whereas the placental thickness growth occurs till late third trimester.²¹ The mean surface area reported by Salafia CM was 247.7sq cm.²² Mahamuda Begum et al.²³ observed the placental surface area were highest (235.12 cm^2) in moderate anaemia as compared to control group (219.26 cm^2) that is highly significant ($p < 0.001$) In the present study, in control group, it is measured as 226.20 ± 44.88 sq. cm and in anaemic pregnancies as 260.08 ± 63.11 sq. cm and also increased by severity of anaemia. Singla et al.¹⁶ recorded the mean placental surface area in normal term pregnancies as 233 ± 47 sq. cm and in anaemic group it is not significantly reduced.

Thus, in present study the mean surface area of the placenta in anaemic pregnancies is found to be on higher side than in the non anaemic pregnancies, it may be because of hypertrophy of placenta (Relative hypoxia as in anaemia).

3. Placental Volume

In present study it measured in non anaemic pregnancies as 479.46 ± 96.20 cu.cm and in anaemic pregnancies is 566.89 ± 136.91 cu.cm. Singla et al.¹⁶ recorded the mean placental volume in normal term pregnancies as 386 ± 73 ml and in anaemic group it is not significantly reduced. Dhall U.¹⁵ found the mean placental volume in control group as 450.33 ± 85.50 cc and in anaemic group as 434.84 ± 87.70 cc. Thus, in present study the mean placental volume in anaemic pregnancy is found to be on higher side than that in the non anaemic pregnancies which is not similar with above studies.

CONCLUSIONS

Maternal anaemia result in fetal hypoxemia and also stimulates placental growth, from results of the present study, it can be concluded that placental weight in anaemic pregnancies is weighed more than that of non-anaemic pregnancies and it is increased as per severity of anaemia. Surface area and volume of the placenta is also increased in anaemic group than non anaemic group and these are increased as per severity of anaemia. Thus from present study, it is concluded that placenta show adaptative changes to anaemia and that the extent of these changes are likely to effect the fetal outcome. The information regarding of placental morphometry is useful for the academics and medical practitioner to interpret the various fetal and maternal data.

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