

**MORPHOMETRIC STUDY OF PLACENTA AND ITS CORRELATION IN NORMAL AND HYPERTENSIVE PREGNANCIES.****PRADEEP S LONDHE*¹, ABHAY B MANE ²**

¹Associate Professor, Department of Anatomy , Chalmeda AnandRao Institute of Medical Sciences, Bomakkal, Karimnagar, Andhra Pradesh

²Associate Professor, Department of Community Medicine, Navodaya Medical College, Raichur, Karnataka-584103

**PRADEEP S LONDHE**

Associate Professor Department of Anatomy Chalmeda AnandRao Institute of Medical Sciences, Bomakkal, Karimnagar, Andhra Pradesh

*Corresponding author

ABSTRACT

Placenta is a vital organ for maintaining pregnancy and promoting normal foetal development. Foetal outcome is adversely influenced by pathological changes observed in placenta. Pregnancy complications like hypertension are reflected in placenta. The objective was to assess the morphology of placenta in normotensive and hypertensive pregnancies and to correlate the morphometric analysis with fetal parameters between the two groups. A Cross-sectional descriptive study was undertaken in the Department of Anatomy, Chalmeda Anandrao Institute of Medical Sciences, Karimnagar, Andhra Pradesh. Total 300 human placentae, 150 from hypertensive pregnancies were studied for the morphology and compared with 150 placentae from normal pregnancies. The morphometric parameters of placenta like weight, volume were significantly lower in hypertensive group compared to normal group. Placental weight and placental volume had significant correlation with the birth weight of new born. Pregnancy induced hypertension is associated with substantial changes in placental morphology due to reduced uteroplacental blood flow.



KEY WORDS

Placenta, Morphology, Hypertension, Pre-eclampsia

INTRODUCTION

Placenta is a leading cause of maternal and perinatal mortality and an important factor in fetal growth retardation¹. Survival and growth of foetus is essentially dependent on formation, full development and functions of the placenta. It is a mirror which reflects the intrauterine status of the foetus. It depicts the most accurate record of the prenatal experience of an infant. It undergoes different changes in weight, volume, structure, shape and function continuously throughout the gestation to support the prenatal life². The examination of the placenta in utero as well as postpartum, gives valuable information about the state of the foetal well being³. Careful examination of placenta can give information which can be useful in the management of complications in mother and the newborn.

The Maternal mortality rate in India has declined from 570 in 1990 to 230 per one lakh population in 2008⁴. But, still it remains high in comparison to developed countries and is largely preventable. The hypertensive disorders are responsible for 5-8 % of all maternal deaths⁵. Pregnancy complications like hypertension or gestational diabetes are reflected macroscopically and microscopically in the placenta^{6, 7, 8, 9}. Placental morphologic changes vary substantially in pre-eclampsia and eclampsia that affects the growth of foetus. In pregnancy induced hypertension, there is increased resistance to utero-placental circulation which adversely affects the growth of placenta in terms of weight, thickness, surface area and volume. These abnormalities ultimately result in unfavourable outcome of pregnancy with reduction of fetal weight. Hence, this study was done to find and correlate the morphological parameters of placenta with the foetal parameters in a subpopulation of Andhra Pradesh.

MATERIALS & METHODS

The study was conducted at the Department of Anatomy. 300 placentae expelled during normal delivery and during caesarian section were collected from the Department of Obstetrics & Gynecology during the period of April 2010 to March 2011. The study group comprised 150 placentae from pregnancies with pre-eclampsia and eclampsia. Those women who had blood pressure at or above 140/90 mm of Hg on atleast two occasions 6 hours apart after 20 weeks of gestation, with or without edema and /or proteinuria formed the study group^{10, 11}. None of these cases had hypertension prior to pregnancy. The control group comprised 150 placentae from pregnant women without pre-eclampsia, normal blood pressure, no proteinuria and without edema.

Before the study, permission was taken from the Institutional Ethics Committee and the Professor and Head of Obstetrics and Gynecology. Informed consent was taken from the parents of the baby. A detailed history of mother regarding the socio-demographic profile, present and past obstetric history were recorded on a predesigned, pretested proforma. All placentae were collected immediately after delivery and washed in running tap water. Any abnormality of cord and membranes was noted. The placentae along with cord were coded and preserved in 10 % formalin solution.

Gross examination of placenta:

Weight of placenta in grams, diameter of placenta in centimeter, shape of the vessels, the site of umbilical cord insertion, the membranes if it is complete or not, color of the fetal surface, muconium stain, the shape of the placental disc, maternal surface if it is complete

or not, number of cotyledons, presence of calcification were recorded. All the morphometric parameters of the placentae were recorded using standard procedures.

Statistical processing of data:

The collected data was entered on the excel spreadsheet, processed and analysed by using the SPSS 17.0 version. Data was analysed by calculating mean, proportions and correlations. The tests of significance applied were Chi-square test, unpaired 't' test, Correlation coefficient.

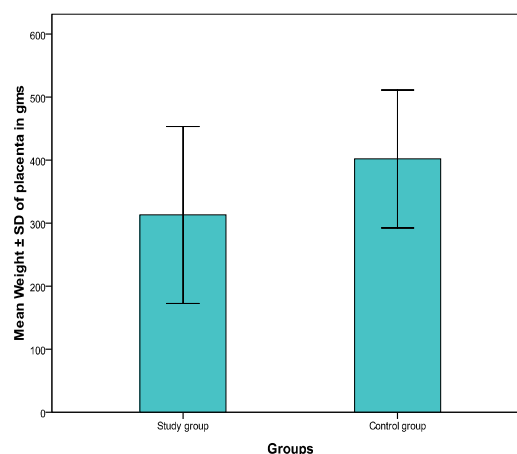
RESULTS

The total placentae collected and examined for the study were 300. Out of which 150 placentae belonged to study group and remaining 150 belonged to control group. Out of 150 placentae of study group, 44 were from full term normal babies between 38 to 42 weeks of gestation and birth weight more than 2500 grams while remaining 106 were from small for gestational age babies between 38 to 42 weeks of

gestation and birth weight less than 2500 grams. Out of 150 placentae of control group, 103 were from full term normal babies between 38 to 42 weeks of gestation and birth weight more than 2500 grams while remaining 47 were from small for gestational age babies between 38 to 42 weeks of gestation and birth weight less than 2500 grams. The age of the mothers ranged between 18 to 35 years with a mean age of 24.05 years (Standard deviation/ SD of ± 2.94) in study group and 23.17 years (SD ± 2.51) in control group. Gestational age of the mother was between 36 to 42 weeks.

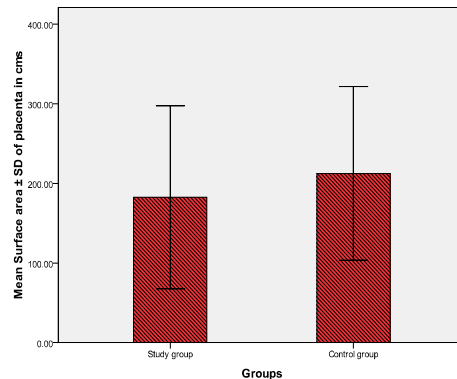
Majority of placenta showed central attachment of cord in 93 % cases while the remaining 7% had marginal attachment. Incidence of fresh infarction was found on maternal surface in 10% of the placentae. All the morphometric parameters of the placentae like placental weight, volume and surface area of the placenta were measured and compared with control groups. In the present study, the mean (\pm SD) weight of the placenta was 312.93 ± 70.14 gm in study group and 401.80 ± 54.62 gm in control group (Figure 1).

Fig 1
Comparison of Mean Placental weight between two groups



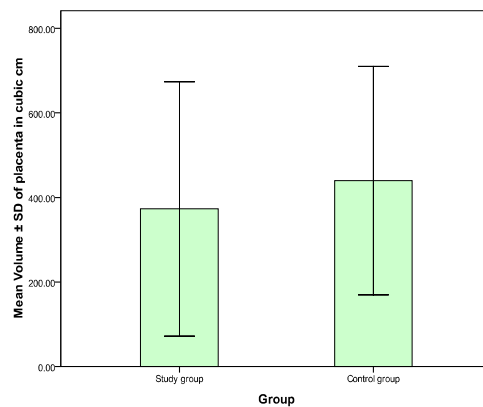
The mean surface area of placenta in study group was 182.80 ± 57.4 as compared to 212.48 ± 54.5 in control group (Figure 2).

Fig 2
Comparison of Mean Surface area of placenta between two groups



As depicted in figure 3, the mean \pm SD absolute volume of the placenta was $372.87.90 \pm 150.36$ and 439.48 ± 135.14 cubic cm in study group and control group respectively

Fig 3
Comparison of Mean Placental Volume between two groups



It was found that all placental morphometric parameters were lower in the hypertensive group as compared to the control group. Applying *t* test, the difference in the mean values between two groups was found to be significant (Table 1).

Table 1
Placental morphometry between hypertensive and normal pregnancies

Parameters	Hypertensive Group	Normal Group	P Value
Placental weight (gm)	312.93 ± 70.14	401.80 ± 54.62	<0.01*
Placental area (sq.cm)	182.80 ± 57.47	212.48 ± 54.51	<0.01*
Placental volume (CC)	372.87 ± 150.36	439.48 ± 135.14	<0.01*
Foeto-placental weight ratio	7.23 ± 1.90	6.79 ± 2.04	< 0.01*
Birth weight of baby (gm)	2260 ± 560	2730 ± 410	< 0.01*

SD- Standard deviation, * Unpaired *t* test- Highly Significant

The mean birth weight of newborn baby in study group was 2268 grams and in control

group was 2732.82 grams. This indicates that mean birth weight of newborn baby was low

in study group and the difference between the groups was statistically significant (Figure 6).

Fig. 4.
Normal full term placenta showing maternal surface with cotyledons.

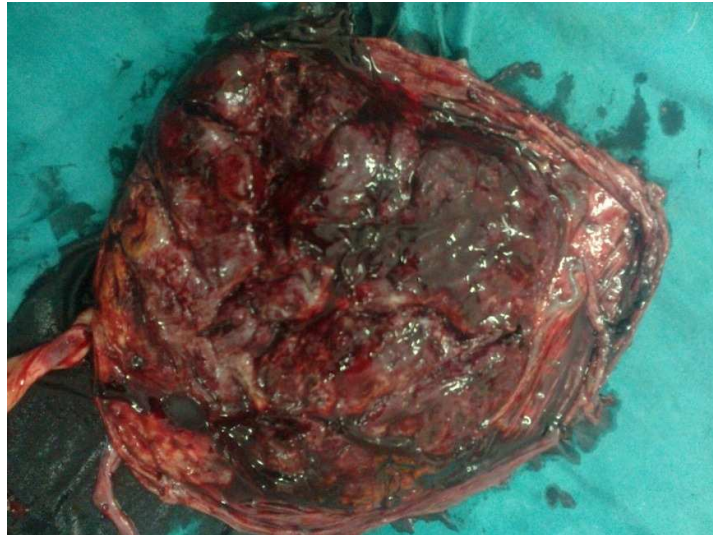
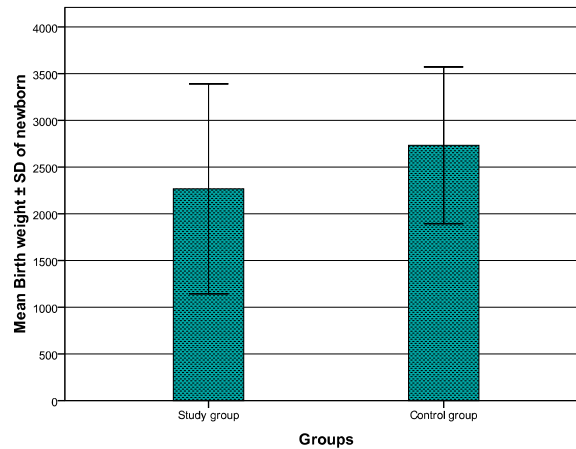


Fig. 5.
Placenta from a case of eclampsia showing maternal surface with cotyledons.



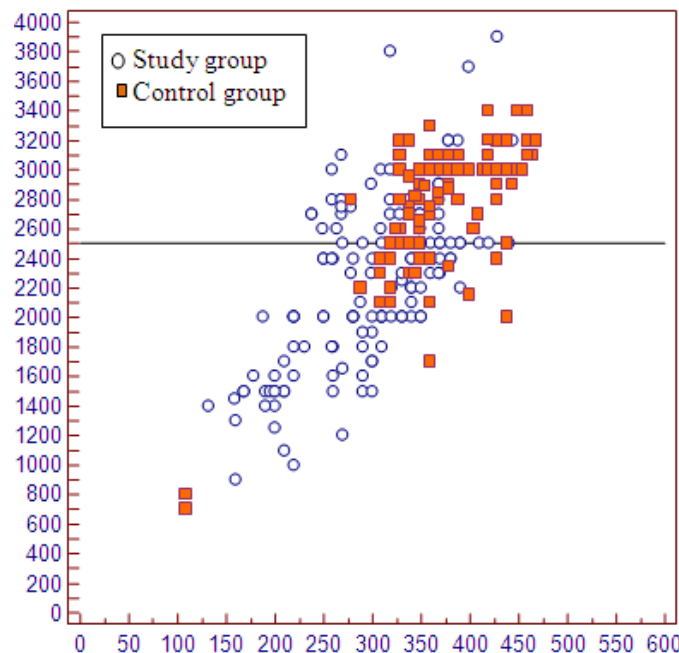
Fig .6.
Comparison of fetal outcome as mean birth weight between two groups



In both the groups there was a significant positive correlation between birth weight and placental weight (Correlation coefficient=0.759, $P < 0.01$, Significant) and between birth weight and placental volume

(Correlation coefficient=0.778, $P < 0.01$, Significant). It was also noted that the birth weights in study group showed more clustering below 2500 grams (Fig 7).

Fig .7.
Relation between placental weight and birth weight of newborn among two groups



The mean fetoplacental weight ratio was significantly higher in study group than in the control group. The mean number of cotyledon was reduced significantly ($p < 0.05$) in study group. The mean number of infarcted and

calcified areas had significantly higher values in the study group than control group (Table 2). The incidence of marginal insertion of cord had significant values which were 81 % in study group and 19 % in control group

Table 2
Gross morphology of placenta in hypertensive and normal pregnancies

Parameters	Hypertensive		Normal
	Group	Group	P value
Mean No. of cotyledons	14.37± 2.56	16.09± 1.90	<0.01*
Mean No. of infarcted area	15.5± 3.2	4.76± 1.86	< 0.01*
Mean No. of calcified areas	11.2± 2.18	3.68± 1.15	< 0.01*
Marginal insertion of cord (%)	11.3	2.7	<0.01 [#]
Presence of infarcted areas (%)	16.7	3.3	< 0.01 [#]

* Unpaired t test <0.01- Highly Significant, # Chi-square test <0.01- Highly Significant

The prevalence of low birth weight (< 2500 gm) was more in the study group than control

group. This difference was found to be significant statistically as shown in table 3.

Table 3
Cross tabulation of birth weight of newborn in hypertensive and normal pregnancies

Birth weight	Hypertensive	Normal	Total
	Group (%)	Group (%)	(%)
Less than 2500 grams	106 (69.3)	47 (30.7)	153 (100)
More than 2500 grams	44 (29.9)	103 (70.1)	147 (100)
Total	150 (50.0)	150 (50.0)	300 (100.0)

Chi-square= 46.43, df- 1, P < 0.01, Highly significant.

DISCUSSION

Morphometric parameters of placenta like, weight, volume were significantly lower in hypertensive group as compared to normal group were statistically significant (p<0.01). This study had similarities to the study conducted by Majumdar et al¹² and Virupaxi R.D et al¹³. As the severity of hypertension increases, placental weight decreases and the incidence of Intrauterine growth retardation rises. Mean surface area of placenta is significantly less in hypertensive group. In a recent study, the mean placental surface area in hypertensive group was 209.36 cm² and 254.63 cm² in the control group¹⁴. This finding in the present study was lower and could be due to regional variations. The placentae from hypertensive patients were significantly smaller than the normal. The absolute volume of placenta was significantly lowered in the

hypertensive group than the control group¹⁵. This is similar to the observation of Boyd and Scott¹⁶ and Teasdale¹⁷. The mean fetoplacental weight ratio was more in hypertensive group than control group. The same ratio was found less in the hypertensive group than control group by Garg et al¹⁸. In the present study infarcted areas, calcified areas were seen significantly more on the placenta in hypertensive group as noted by others¹⁹. Cotyledon numbers were found to be significantly less in hypertensive group which is similar to the findings of the study by Sultana S and et.al²⁰. Marginal insertion of umbilical cord in 11.3 % hypertensive cases in the present study was lower than 42 % reported by Pretorius²¹. This finding has also been implicated in the induction of hypertension^{22, 23}.



The mean birth weight of newborn baby was less in hypertensive group. Relations between birth weight and placental area and placental volume have also been described by other workers^{24, 25}. This has been attributed to the significant alteration in the morphometry of placenta due to increase in the cytotrophoblastic cellular proliferation and syncytial knot formation in the placental villi that result in the disturbance of hormonal factors.

CONCLUSION

The morphometry of placenta like weight, surface area and volume show significantly lower values in the hypertensive group than the normotensive group. Placental weight and size are directly proportional to the birth weight of babies. Hypertensive disorders in pregnancy influence the morphology of placenta which adversely affects the perinatal outcome. The early measurements of placenta by non-invasive technique like ultrasonography will be helpful in early identification of at risk fetus and better management of such pregnancies.

REFERENCES

1. Roberts JM, Cooper DW. Preeclampsia triad. Pathogenesis and genetics of preeclampsia. *The Lancet*, 357: 53-6, (2001).
2. Teasdale F. Gestational changes in the functional structure of the human placenta in relation to fetal growth: a morphometric study. *Am J Obstet Gynecol*, 137: 560-3, (1980).
3. Kouvalainen K, Pynnonen AI, Makarainen M, Peltonen T. Weights of placental membranes and umbilical cord. *Duodecim*, 87:1210-1214, (1971).
4. <http://www.ndtv.com/article/india/india-doing-well-in-reducing-maternal-mortality-unicef-53618>. [Accessed on 20 June 2011].
5. Park K. Textbook of Preventive and Social Medicine, 20th edn, Banarsidas Bhanot Publishers, Jabalpur: Pg 482, (2009).
6. Segupta K, Shamim A, Khandaker AR, Mahamuda B. Morphological Changes of Placenta in Preeclampsia. *Bangladesh Journal of Anatomy*, 7 (1): 49-54, (2009).
7. Browne JCM, Veall N. The maternal blood flow in normotensive and hypertensive women. *J Obst Gynaecol of British Empire*, 60:141-147, (1953).
8. Stock MH, Anderson DF, Phernetham TM. Vascular response of the maternal placental vasculature. *J Dev Physiol*, 2: 239-246, (1980).
9. Fox, H; The placenta in intra uterine growth retardation. In Ward RHT, Smith SK, Donnai D (Eds). Early foetal growth and development. RCOG Press, London, 223 -235, (1994).
10. Report of a WHO study group on Hypertensive disorders of pregnancy. World Health Organization, Geneva (1987).
11. Report of National High Blood pressure Education Program working group on high blood pressure in pregnancy. *Am J Obstet Gynecol*, 183: S1-S22, (2000).
12. Majumdar S, Dasgupta H, Bhattacharya K, Bhattacharya A. A study of Placenta in Normal and Hypertensive Pregnancies. *J. Anat. Soc. India*, 54 (2): 1-9, (2005).
13. Virupaxi RD, Potturi BR, Shirol VS, Desai SP, Hukkeri VB. Morphology of Placenta and its Relation with Small for Date Babies in 950 Live Births. *Rec Res Sci Tech*, 3:123-126, (2011).
14. Rath G, Garg K, Sood M. Insertion of umbilical cord on the placenta in hypertensive mother. *J. Anat. Soc. India*, 49 (2): 149-152, (2000).
15. Kishwara S, Nurunnabi ASM, Begum M, Ahmed R, Ara S. Study of proportional and absolute volume of placental parenchyma and nonparenchyma between normal



- pregnant and preeclamptic women. *J Dhaka Med Coll*, 17(2): 78-82, (2008).
16. Boyd PA, Scott A. Quantitative structural studies on human placentas associated with preeclampsia, essential hypertension and intrauterine growth retardation. *Br J Obstet Gynecol*, 92: 714-21, (1985).
 17. Teasdale F. Histomorphometry of the human placenta in preeclampsia associated with severe intrauterine growth retardation. *Placenta*, 8: 119-28, (1987).
 18. Garg K, Rath G, Sharma S. Association of birth weight, placental weight and the site of umbilical cord insertion in hypertensive mothers. *J. Anat. Soc. India*, 44:4, (1996).
 19. Udainia A, Bhagwat SS, Mehta CD. Relation between placental surface area, infarction and foetal distress in pregnancy induced hypertension with its clinical relevance. *J. Anat. Soc. India*, 53 (1): 27-30, (2004).
 20. Sultana S, Hossain GA, Rahman MH, Hasan N, Sultana SZ, Khalil M. Changes of placental diameter thickness and cotyledon in eclampsia. *Mymensingh Med J*, 16 (2): 127-31, (2007).
 21. Pretorius DH, Chau C, Poeltler DM, Mendoza A, Catanzarite VA, Hollenbach KA. Placental cord insertion, visualisation with prenatal ultrasonography. *J Ultrasound Med*, 15: 585-593, (1996).
 22. Di Salvo DN, Benson CB, Laing FC, Brown DL, Frates MC, Doubilet PM. Sonographic evaluation of the placental cord insertion site. *Am J Roentogenol*, 170: 1292-1298, (1998).
 23. Alexander DK, Mary Penry RN, Melissa Swain RN, Christos GH. Effect of placental laterality on uterine artery resistance and development of preeclampsia and intrauterine growth retardation. *Am J Obstet Gynecol*, 161: 1536-9, (1989).
 24. Das B, Dutta D, Chakraborty S, Nath P. Placental morphology in hypertensive disorders of pregnancy and its correlation with fetal outcome. *J Obstet Gynecol India*, 46 (1): 40-46, (1996).
 25. Udainia A, Jain ML. Morphological study of placenta in pregnancy induced hypertension with its clinical relevance. *J. Anat. Soc. India* 50 (1) 24-27, (2001).