

Study the morphology and the morphometric measurements of placenta among normotensive and pregnancy-induced hypertension pregnancies

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Abstract

Background: Placental pathology has undoubtedly received very little attention by both the obstetricians and pathologist. The various indications for placental examination are essentially any maternal disease or disorders of the infant or any other clinically accepted placental abnormality. The aim and objectives of the present study were study of the morphology, morphometry and site of umbilical cord insertion in the placenta of women with normal and PIH pregnancy and correlation of the changes observed in morphology, morphometric measurements and sites of umbilical cord insertion. **Materials and Methods:** The cases were then divided into two main groups: pregnancy cases without any complication or normal pregnancy (n=50) and pregnancy cases with PIH (n=50). Each group comprised of patients having known LMP (last menstrual period), EDD (expected date of delivery), blood pressure and gestational period ranging from 35 to 40 weeks. At labour room placentae were collected as fresh specimen after delivery and then examination was carried out in the following way: morphological and morphometrical. In the morphological study, following facts were kept in mind while examining the gross anatomical features of placenta like placental completeness, placental shape, placental consistency, placental parenchyma and umbilical cord insertion. For morphometric study: *placental weight, volume, thickness, diameter, circumference, cord insertion percentage/site* and area were noted. The diameter of placenta was measured with a measuring tape twice. The average of maximum and minimum diameter is the diameter of the placenta. **Results:** In the present study the mean placental weight seen in case of PIH pregnancy series was 486.9 ± 37.08 grams with a maximum weight of 566 grams and a minimum weight of 382 grams. In PIH case studies the maximum volume of placenta was 515 cc and minimum 302 cc with an average of 406.4 ± 36.77 cc. Maximum placental area was recorded in our studies was 249 sq.cc and minimum was 102.7 sq.cc, with an average of 172.5 ± 24.76 sq.cc. In our studies maximum thickness of placenta was observed 2.2 cm and minimum thickness was 0.9 cm with an average of 1.48 ± 0.15 cm. In our cases the maximum diameter was observed 17.8 cm and minimum was 10.8 cm with an average of 14.76 ± 0.33 cm. In this PIH case series the maximum placental circumference was 52.5 cm and minimum circumference was 31.6 cm with an average circumference was 45.66 ± 2.09 cm. In this study we found maximum ratio of 5.58 and minimum ratio of 4.2 with the average ratio of 4.65 ± 0.35 . In normal pregnancy groups- 50 placentae were studied of which 16 (32%) had central type insertion, 14 (28%) had medial, 5 (10%) had lateral type and 165 (30%) had marginal type of cord insertion. In PIH pregnancy groups- 50 placentae were studied of which 19 (38%) had central type insertion, 11 (22%) had medial, 4 (8%) had lateral type and 16 (32%) had marginal type of cord insertion. **Conclusion:** In our study we found that hypertensive placentae tend to be slightly smaller in size, weight, volume, area, thickness, diameter, circumference and foeto-placental ratio than normal placentae. Placenta undergoes different changes in weight, volume, structure, shape and function continuously throughout the gestation to support the prenatal life. Pregnancy complications like hypertension reflected macroscopically and microscopically in the placenta.

Keywords: Placenta, morphology, morphometry, foeto-placental ratio, pregnancy induced hypertension

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Introduction

The placenta is a unique characteristic of higher mammals which is

attached to the uterus and is connected to the foetus through the umbilical cord. Researchers have, for a long time, emphasized the benefits which are associated with the anatomical examination of the placenta, an organ that is often disposed soon after parturition, without adequate examination. The examination of the placenta in utero as well as postpartum, gives valuable information about the state of the foetal well being [1, 2]. The placental mass maintains a relationship with the weight of developing fetus in pregnancy.

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Thomson et al. conducted a study in women with normal blood pressure, and it was observed that there is a relation among birth weight, placental surface area, and placental volume and concluded that the placental size and weight are directly proportional to the birth weight [3]. Preeclampsia (PE) or pregnancy induced hypertension (PIH), a pregnancy specific vasoconstrictive condition, is defined as the occurrence of hypertension and significant proteinuria in a previously healthy woman on or after the 20th week of gestation [4]. Major maternal complications include disseminated coagulopathy, acute renal failure, liver impairment, pulmonary oedema, and seizures (eclampsia). PE increases maternal long-term health risks of later hypertension, stroke, and ischemic heart disease [5]. Hypertension has an impact on placenta significantly as pregnancy complications. Therefore examination of placenta gives a clear picture of what had happened with it during any complication associated with pregnancy [6]. Globally, nearly 10% of all pregnancies are complicated by hypertension and is responsible for a huge burden of maternal as well as prenatal morbidity and mortality [7, 8]. It is also estimated that pregnancy induced hypertension (PIH), one of the hypertensive disorders of pregnancy, affects about 5-8% of all pregnant women worldwide.4 Among pregnancies complicated by hypertension a number of structural, morphological and vascular changes take place in placenta during pregnancy.5-7 The complications of hypertensive disorders in pregnancy have been attributed to abnormalities in the placenta [9-11]. The examination of placenta in utero as well as postpartum provides much insight into the prenatal health of the baby and the mother [1]. In mothers who have had no previous antenatal check up, a thorough examination of the placenta will help in the early diagnosis of the foetal complications, soon after parturition and thus helps in the early treatment of the baby by neonatologists especially in a rural setup where even today the mothers land into the labour ward with no prior investigation done. Grossly, the pre-eclamptic placentae are lesser in weight, diameter, and thickness, with an increase in the incidence of abnormal shape and cord insertion, and diminished fetoplacental ratio. Furthermore, there seems to be a higher incidence of infarction and retroplacental hematoma, in pre-eclamptic placentae. The numerous placental changes bear a direct relation to severity and duration of the disease process. The fetal outcome is adversely influenced by the pathological changes in the placenta [12]. The aim and objectives of the present study were study of the morphology, mophometry and site of umbilical cord insertion in the placenta of women with normal and PIH pregnancy and correlation of the changes observed in morphology, morphometric measurements and sites of umbilical cord insertion.

Materials & methods

After acquiring institutional ethical approval and informed patient consent, the materials of the present study i.e. placentae were collected at random from pregnancy cases attending the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital, Haldia during the period from Jan-2019 to Dec-2020. A total number of 100 cases were included in this study. All the cases included in this study were booked cases. In each case antenatal check up was done routinely. The cases were then divided into two main groups: pregnancy cases without any complication or normal pregnancy (n=50) and pregnancy cases with PIH (n=50). Each group comprised of patients having known LMP (last menstrual period), EDD (expected date of delivery), blood pressure and gestational period ranging from 35 to 40 weeks. In each case antenatal record having patient’s demographic information were recorded. Clinical studies

were done during pregnancy as well as in labour and post partum period. At labour room placentae were collected as fresh specimen after delivery and then examination was carried out in the following way: morphological and morphometrical.

Morphological study: following facts were kept in mind while examining the gross anatomical features of placenta like placental completeness, placental shape, placental consistency, placental parenchyma and umbilical cord insertion.

Morphometric study: *Placental weight, volume, thickness, diameter, circumference, cord insertion percentage/site* and area were noted. The diameter of placenta was measured with a measuring tape twice. The average of maximum and minimum diameter is the diameter of the placenta.

Area – The placental area was estimate by the formula [13]-

$$\frac{\pi}{4} \times \frac{(\text{Maximum diameter (cm)})^2 + (\text{Minimum diameter (cm)})^2}{2}$$

Or $3.14 \times r_1 \times r_2$

[r1=maximum diameter; r2=minimum diameter]

Circumference – circumference was calculated by the formula

$$\pi \times \frac{\text{maximum} + \text{minimum diameter (cm)}}{2}$$

Or $3.14 \times \frac{\text{average diameter}}{2}$

Cord insertion percentage/site – The minimum distance of the site of cord insertion and the margin of the placenta was measured and denoted as “x”. Assuming the placenta to be a perfect circle the mean radius “r” was obtained and then the insertion percentage = x/r x100. A low insertion percentage indicates marginal insertion while high value indicated centrally inserted cord.

According to this calculation placenta was divided into four groups [14, 15]-

- I. Central cord insertion (76 - 100 insertion percentage)
- II. Medial cord insertion (51 - 75 insertion percentage)
- III. Lateral cord insertion (26 - 50 insertion percentage)
- IV. Marginal cord insertion (0 - 25 insertion percentage)

Examination of the baby

The time and mode of delivery was noted in each case. The birth weight, APGAR score, sex and length of the baby were noted in the labour room. Determination of fetoplacental ratio: In each case the ratio was calculated by dividing the baby’s birth weight by placental weight and this was also recorded.

Results

In the present study placentae were collected at random from pregnancy cases attending the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital, Haldia, West Bengal during the period from Jan-2019 to Dec-2020. A total number of 100 cases were included in this study [Table 1]. Out of these specimens, 50 were collected from normal uncomplicated pregnancy cases and 50 from cases complicated by hypertension. About 50% of the total cases were from normal pregnancy group (50) and 50% of total cases each was from hypertensive mothers (50 cases in each group).

Table 1: Division of different groups in the present study [n=100]

Groups	Case Types	Case No	Percentage
Group A	Normal	50	50%
Group B	Hypertensive	50	50%

Mother included in this study was from different age groups starting from 19 to 45. Percentage of participants in age groups 19-30 yrs, 31-40 yrs and 41-45 years were 37%, 52% and 11% respectively [Table 2].

Table 2: Age distribution of study participants [n=100]

Age range	No of mother	Percentage
19 – 30	37	37%
31 - 40	52	52%
41- 45	11	11%

Table 3: Placental morphometry in case of normal uncomplicated pregnancies along with birth weight and feto-placental ratio

Normal pregnancies	Placental parameters	Maximum	Minimum	Average [SD]
50	Placental weight (gm)	582	349	514.8 ± 62.8
	Placental volume (cc)	525	312	437.8 ± 37.39
	Placental area (sq.cm)	218.8	117.7	187.2 ± 25.62
	Placental thickness (cm)	2.3	0.9	1.76 ± 0.19
	Placental diameter (cm)	18.3	11.8	15.60 ± 0.40
	Placental circumference (cm)	56.3	38.4	49.21 ± 1.44
	Birth weight of baby (kg)	3.2	1.8	2.67 ± 0.30
	Feto-placental ratio	5.84	4.85	5.13 ± 0.27

Placental weight may become the single most important factor in determining the fetal maturity. In this study the mean placental weight seen in case of normal pregnancy series was 514.8 ± 62.8 grams with a maximum weight of 582 grams and a minimum weight of 349 grams [Table 3]. In normal case studies the maximum volume of placenta was 525 cc and minimum 312 cc with an average of 437.8 ± 37.39 cc. Maximum placental area was recorded in our studies was 218.8 sq.cc and minimum was 117.7 sq.cc, with an average of 187.2 ± 25.62 sq.cc. In our studies maximum thickness of placenta was observed 2.3 cm and minimum thickness was 0.9 cm with an average of 1.76 ± 0.19 cm. In our cases the maximum diameter was observed 18.3 cm and minimum was 11.8 cm with an average of 15.60 ± 0.40 cm. In this case series the maximum placental circumference was 56.3 cm and minimum circumference was 38.4 cm with an average circumference was 49.21 ± 1.44 cm. In this study we found maximum ratio of 5.84 and minimum ratio of 4.85 with the average ratio of 5.13 ± 0.27 [Table 3].

Table 4: Placental morphometry in case of pregnancy with hypertension, along with birth weight and feto-placental ratio

Hypertensive pregnancies	Placental Parameters.	Maximum	Minimum	Average [SD]
50	Placental weight (gm)	566	382	486.9 ± 37.08
	Placental volume (cc)	515	302	406.4 ± 36.77
	Placental area (sq.cm)	249	102.7	172.5 ± 24.76
	Placental thickness (cm)	2.2	0.9	1.48 ± 0.15
	Placental diameter (cm)	17.8	10.8	14.76 ± 0.33
	Placental circumference (cm)	52.5	31.6	45.66 ± 2.09
	Birth weight of baby (kg)	2.70	1.7	2.40 ± 0.22
	Feto placental ratio	5.58	4.2	4.65 ± 0.35

In this study the mean placental weight seen in case of PIH pregnancy series was 486.9 ± 37.08 grams with a maximum weight of 566 grams and a minimum weight of 382 grams [Table 3]. In normal case studies the maximum volume of placenta was 515 cc and minimum 302 cc with an average of 406.4 ± 36.77 cc. Maximum placental area was recorded in our studies was 249 sq.cc and minimum was 102.7 sq.cc, with an average of 172.5 ± 24.76 sq.cc. In our studies maximum thickness of placenta was observed 2.2 cm and minimum thickness was 0.9 cm with an average of 1.48 ± 0.15 cm. In our cases the maximum diameter was observed 17.8 cm and minimum was 10.8 cm with an average of 14.76 ± 0.33 cm. In this PIH case series the maximum placental circumference was 52.5 cm and minimum circumference was 31.6 cm with an average circumference was 45.66 ± 2.09 cm. In this study we found maximum ratio of 5.58 and minimum ratio of 4.2 with the average ratio of 4.65 ± 0.35 [Table 4].

Table 5: Number of cases in each group with percentages in relation to insertion of umbilical cord on the fetal surface

No. of cases in group	Central type	Eccentric type		
		Medial type	Lateral type	Marginal type
Normal 50 cases	16 (32%)	14 (28%)	5 (10%)	15 (30%)
Hypertensive 50 cases	19 (38%)	11 (22%)	4 (8%)	16 (32%)
Total =100 cases	35 (35%)	25 (25%)	9 (9%)	31 (31%)

From table 5 we got the insertion of umbilical cord on the fetal surface of placenta in normal & pregnancy induced hypertensive mothers. In normal pregnancy groups- 50 placentae were studied of which 16 (32%) had central type insertion, 14 (28%) had medial, 5 (10%) had lateral type and 16 (30%) had marginal type of cord insertion. In PIH pregnancy groups- 50 placentae were studied of which 19 (38%) had central type insertion, 11 (22%) had medial, 4 (8%) had lateral type and 16 (32%) had marginal type of cord insertion.

Table 6: Comparison between normal and hypertensive mothers

Placental parameters	Normal cases.	Hypertensive cases	P Value	Comments
Placental weight (gm)	514.8 ± 62.8	486.9 ± 37.08	0.037*	S
Placental volume (cc)	437.8 ± 37.39	406.4 ± 36.77	0.0093*	HS
Placental area (sq cm)	187.2 ± 25.62	172.5 ± 24.76	0.033*	S
Placental thickness (cm)	1.76 ± 0.19	1.48 ± 0.15	<0.0001*	HS
Placental diameter (cm)	15.60 ± 0.40	14.76 ± 0.33	<0.0001*	HS
Placental circumference (cm)	49.21 ± 1.44	45.66 ± 2.09	0.0005*	HS
Birth weight of baby (kg)	2.67 ± 0.30	2.40 ± 0.22	0.0003*	HS
Feto-placental ratio	5.13 ± 0.27	4.65 ± 0.35	<0.0001*	HS

HS = highly significant. S= Significant. [*p< 0.05 indicates significant]

Table 7: Comparison of gross morphological changes in placental in mothers of different age group

Groups	Average no. of cotyledons	Average no. of infarcted areas	Average no. of calcified regions	Presence of hemorrhage
Normal [n=50]	16	03	05	03
Hypertensive [n=50]	15	15	26	19

Discussion

In the present study placentae were collected at random from pregnancy cases attending the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital, Haldia, West Bengal during the period from Jan-2019 to Dec-2020. A total number of 100 cases were included in this study. Out of these specimens, 50 were collected from normal uncomplicated pregnancy cases and 50 from cases complicated by hypertension. About 50% of the total cases were from normal pregnancy group (50) and 50% of total cases each was from hypertensive mothers (50 cases in each group). In the present study placental weight may become the single most important factor in determining the fetal maturity. In this study the mean placental weight seen in case of normal pregnancy series was 514.8 ± 62.8 grams with a maximum weight of 582 grams and a minimum weight of 349 grams [Table 3]. In normal case studies the maximum volume of placenta was 525 cc and minimum 312 cc with an average of 437.8 ± 37.39 cc. Maximum placental area was recorded in our studies was 218.8 sq.cc and minimum was 117.7 sq.cc, with an average of 187.2 ± 25.62 sq.cc. In our studies maximum thickness of placenta was observed 2.3 cm and minimum thickness was 0.9 cm with an average of 1.76 ± 0.19 cm. In our cases the maximum diameter was observed 18.3 cm and minimum was 11.8 cm with an average of 15.60 ± 0.40 cm. In this case series the maximum placental circumference was 56.3 cm and minimum circumference was 38.4 cm with an average circumference was 49.21 ± 1.44 cm. In this study we found maximum ratio of 5.84 and minimum ratio of 4.85 with the average ratio of 5.13 ± 0.27 [Table 3]. In the Kambale T et al study [16], the mean placental weight was more in the control group (489.1 g) than in the PIH group (405.2 g). These findings are statistically significant. In mild PIH, severe PIH, and eclampsia group, the mean placental weight was 424.8 g, 383 g, and 342 g, respectively. Placental weight decreased as the severity of disease progresses. The mean fetal birth weight in the control group was 2739.7 g, while that in PIH group it was 2079.6 g and also the fetal birth weight decreases with increasing grades of PIH. These findings were statistically significant. Normally, fetoplacental weight ratio varies between 6:1 and 8:1 and in the present study, the fetoplacental weight ratio in normal group was 5.68 and in PIH group it was 5.38 [16].

In the present study the mean placental weight seen in case of PIH pregnancy series was 486.9 ± 37.08 grams with a maximum weight of 566 grams and a minimum weight of 382 grams [Table 3]. In PIH case studies the maximum volume of placenta was 515 cc and minimum 302 cc with an average of 406.4 ± 36.77 cc. Maximum placental area was recorded in our studies was 249 sq.cc and minimum was 102.7 sq.cc, with an average of 172.5 ± 24.76 sq.cc. In our studies maximum thickness of placenta was observed 2.2 cm and minimum thickness was 0.9 cm with an average of 1.48 ± 0.15 cm. In our cases the maximum diameter was observed 17.8 cm and minimum was 10.8 cm with an average of 14.76 ± 0.33 cm. In this PIH case series the maximum placental circumference was 52.5 cm and minimum circumference was 31.6 cm with an average circumference was 45.66 ± 2.09 cm. In this study we found maximum ratio of 5.58 and minimum ratio of 4.2 with the average ratio of 4.65 ± 0.35 [Table 4].

Macroscopic study of the placenta by Nahar L et al [17] revealed placental weight, surface area and number of cotyledons

were less in study group. Mean placental weight in study group was 419.50gm and in control group was 477.50 (p<0.001). Mean surface area in study group & control group were 232.29cm² and 304.80cm² respectively (p<0.001). Mean number of cotyledons were 15.39 and 17.40 in study & control group respectively (P<0.001) and lower diameter of umbilical cord (p<0.04667).

The mean placental weight was found to be 486 ± 124 gm in normal group, 398 ± 98 gm in PIH group, 504 ± 133 gm in anaemia group and 547 ± 138 gm in diabetic group. It was observed that placental weight was quiet low in PIH group than normal. Conversely it was on higher side in anaemia and diabetes group. In different studies, placental weight in hypertensive pregnancies has been reported to vary from 345.96 g to 524.24 g whereas that in normotensive pregnancies ranged from 435.92 g to 557.8 g. [12,13] The difference in placental weight of two groups in present study was 77.77 g [18].

Present study showed normal pregnancy groups- 50 placentae were studied of which 16 (32%) had central type insertion, 14 (28%) had medial, 5 (10%) had lateral type and 165 (30%) had marginal type of cord insertion. In PIH pregnancy groups- 50 placentae were studied of which 19 (38%) had central type insertion, 11 (22%) had medial, 4 (8%) had lateral type and 16 (32%) had marginal type of cord insertion.

The preeclamptic women will have a lower mean gestation, so the proportion of fetal capillaries will be lower. The capillaries become larger as the gestation proceeds. This relative increase in fetal capillary volume with decrease in proportion of connective tissue will lead to smaller parenchymal volume leading to decrease in placental weight [19].

In the Salmani D et al study [20], the average diameter of placenta in control group was 18.62 cm, in preeclamptic cases it was 17.33 cm, and in case of eclamptic cases it was 16.24 cm. The study by Mallik et al. reported that the mean diameter of placenta was 17.54 cm [21]. Cibils reported that placenta from PIH cases were smaller than normal indicating an underlying pathological process interfering with the normal growth of placenta [21]. The majority of cases showed eccentric insertion (82%) and few showed central insertion (18%) in both the control and study groups [20]. Whereas in the earlier studies by Nobis and Das, the pattern of cord insertion was central in 44.19%, eccentric in 42.17%, and battledore in 1.26% [22]. In the Qureshi S et al study [23], we have found the insertion of the umbilical cord as marginal 5% central 7% eccentric 88%. Perry IJ et al [24] reported that in normal birth weight, in 84.2% cases the mode of umbilical cord insertion was central, 72.7% of cases it was marginal and 90% cases eccentric. Studies involving placental villous morphometry have focused on the peripheral (intermediate and terminal) villi, as these villi form the surface for actual maternofetal exchange. Reductions in placental villous and vascular morphology in pregnancies complicated with PE have also been previously reported [25]. The findings of this study support the hypothesis that, in preeclampsia not associated with severe intrauterine growth retardation, the perinatal morbidity associated with this condition is probably related more to some alterations in uteroplacental and, possibly, umbilical blood flows than to significant changes in placental structure and function. This may be due to compensatory repair mechanisms and extensive functional reserve capacities in these placentas [25]. There was no difference in age and height parameters but the weight of hypertensive was found to be higher than normotensive. Morphological features are not

significantly different between the normotensive and hypertensive placenta. The circumference, volume, FP ratio and placental coefficient are not significantly different between normal and hypertensive group. The placental examination provides better understanding of the prenatal health of both the child and mother [26, 27]. Sirpurkar M et al noticed reduction in placental weight in PIH group (398 ± 98 gm) and increased placental weight in anaemia and diabetes groups. The possible explanation can be hypoxia due to anaemia and compensatory increase in blood flow which leads to increase in placental weight in anaemia [18]. Thomson et al (1969) [3] stated that for the evaluation of foetus, weight of the placenta is not enough, but the foeto-placental ratio is important. Increased foeto-placental ratio in hypertensive pregnancies was previously observed by Thomson et al (1969)[3], Saigal et al (1969)[28] and Gunapriya Raghunath et al (2011)[2]. Decreased foeto-placental weight ratio was observed Rath et al [29].

In a study of 100 placentae, mean placental weight was 435.63 ± 103.91 and 371.43 ± 88.52 in mild PIH and severe PIH respectively [30]. Fetal weight also decreased as weight of placenta decreases in hypertensive pregnancy which is in accordance with the present study. Placental weight decreases with increase in severity of hypertension due to uteroplacental vascular insufficiency [31]. The linear relationship of placental weight and fetal weight can be very well showed by mean foeto-placental ratio and placental coefficient. There was reduction in foeto-placental ratio in hypertensive placentae as 6.15:1 (mild PIH), 5.43:1 (severe PIH) and 5.21:1 (eclampsia) when compared to control group and the placental coefficient in PIH was .16 in a study [2, 32, 33], which is similar to our study.

Gupta et al. compared weight, volume, diameter, thickness and surface area of the placenta and found significant strong correlation with the fetal weight. So this means that if there is any abnormality in the placenta, it will be strongly reflected in the fetus [34]. This was in accordance with the present study regarding the surface area, diameter and placental weight which showed significantly positive correlation but the thickness had no correlation with the birth weight in this present study [34]. Majumdar [35] and Kurdukar et al.[36] observed that fetal birth weights were lower in cases of preeclampsia; our findings correlated with these studies. The difference in the mean fetal birth weight observed by different researchers may be due to various factors such as socioeconomic status, races, and nutrition of mother.

Conclusion

In our study we found that hypertensive placentae tend to be slightly smaller in size, weight, volume, area, thickness, diameter, circumference and foeto-placental ratio than normal placentae. Placenta undergoes different changes in weight, volume, structure, shape and function continuously throughout the gestation to support the prenatal life. Pregnancy complications like hypertension reflected macroscopically and microscopically in the placenta.

References

- Kouvalainen k, Pynnonen AI, Mkaarainen M, Peltonen T. Weights of placental membranes and Umbilical cord. *Duodecim*. 1971;87(17):1210-1214.
- Raghunath G, Vijayalakshmi, Shenoy V. A study on the morphology and the morphometry of the human placenta and its clinical relevance in a population in Tamilnadu. *Journal of Clinical and Diagnostic Research*. 2011 Apr; 5(2):282-286
- Thomson, Younoszai M.K, Haworth J.C. Placental dimensions, and relations in pre-term, term, and growth retarded infant. *American Journal of Obstetrics and Gynaecology* 1969; 103: 265-271.
- Eiland E, Nzerue C, Faulkner M. Preeclampsia 2012. *J Pregnancy*. 2012;2012:586578.
- Staff AC, Dechend R, Pijnenborg R. Learning from the placenta: acute atherosclerosis and vascular remodeling in preeclampsia-novel aspects for atherosclerosis and future cardiovascular health. *Hypertension*. 2010 Dec;56(6):1026-34.
- Holland E, Brews A, Percival. *Manual of obstetrics* (14th ed.). Edinburgh. English Language Book Society; Churchill Livingstone, 1980.
- Muti M, Tshimanga M, Notion GT, Bangure D, Chonzi P. Prevalence of pregnancy induced hypertension and pregnancy outcomes among women seeking maternity services in Harare, Zimbabwe. *BMC Cardiovasc Disorders*. 2015;15:111.
- Ye C, Ruan Y, Zou L, Li G, Li C, Chen Y, et al. The 2011 Survey on hypertensive disorders of pregnancy (HDP) in China: prevalence, risk factors, complications, pregnancy and perinatal outcomes. *PLoS One*. 2014;9(6):e100180.
- Arshad A, Pasha W, Khattak TA, Kiyani RB. Impact of pregnancy induced hypertension on birth weight of newborn at term. 2011;15(2):113-5.
- Kurdukar, Deshpande NM, Shete SS, Zawar MP. Placenta in PIH. *Indian J Pathol Microbiol*. 2007; 50(3):493-7.
- Chhatwal J, Chaudhary DN, Chauhan N. Placental changes in hypertensive pregnancy: a comparison with normotensive pregnancy. *Int J Reprod Contracept Obstet Gynecol* 2018; 7:3808-13.
- Prathiba A, Einstien D, Subramanian V, Mahendranath P, Murugesan S. Comparative study of placental morphometry and histomorphology in normal and pre-eclamptic pregnancies. *Int J Sci Stud* 2016;4(9):96-99.
- Pryse DJ, Beazley JM., Leach G. A study of placental size and chorioamnionitis in a consecutive series of hospital deliveries. *Br. J. Obstet. Gynaecol* 1973; 80:246-51.
- Redman CW. Stress responses and pre-eclampsia. *Pregnancy Hypertens*. 2013;3(2):57.
- Brosens I, Robertson WB, Dixon HG. Fetal growth retardation and the vasculature of the placental bed. *Br J Obstet Gynaecol*. 1977;84:656-64.
- Kambale T, Iqbal B, Ramraje S, Swaimul K, Salve S. Placental morphology and fetal implications in pregnancies complicated by pregnancy-induced hypertension. *Med J DY Patil Univ* 2016;9:341-7.
- Nahar L, Nahar K, Hossain MI, Yasmin H, Annur BM. Placental changes in pregnancy induced hypertension and its impacts on fetal outcome. *Mymensingh Med J*. 2015;24(1):9-17.
- Sirpurkar M, Anjankar VP. Study of correlation between placental morphology and adverse perinatal outcome in different conditions affecting pregnancy. *Int J Reprod Contracept Obstet Gynecol* 2015;4:1165-8.
- Boyd PA, Scott A. Quantitative structural studies on human placenta associated with preeclampsia essential hypertension and intrauterine growth retardation. *Br J Obstet Gynaecol*. 1985;92:714-21.
- Salmani D, Purushothaman S, Somashekara SC, et al. Study of structural changes in placenta in pregnancy-induced hypertension. *J Nat Sci Biol Med*. 2014;5(2):352-355.
- Cibils LA. The placenta and newborn infant with hypertension conditions. *Am J Obstet Gynaecol*. 1974;118:256-70.
- Nobis P, Das U. Placental morphology in hypertensive pregnancy. *J Obstet Gynecol*. 1991;41:166-9.
- Qureshi S, Singh J, Fulwaria M, Yadav OP. A study to find out association between morphometry of placenta and neonates profile at tertiary care teaching hospital, Bikaner. *Int. J. Med. Sci. Educ*. July-September 2018; 5(3):359-363.
- Perry JJ, Beevers DG, Whincup PH, Bareford D. Predictor of ratio of placental weight to fetal weight in multiethnic community. *BMJ* 1995; 310:436-9.
- Teasdale F. Histomorphometry of the human placenta in maternal preeclampsia. *Am J Obstet Gynecol*. 1985;152(1) :25-31.
- Akshara VR, Ramakrishnan PK, Chitra S, Sailesh KS, Seema Valsalan E. Morphology and the morphometric measurements

-
- of hypertensive and normotensive placenta. Biomedical Research 2018; 29 (18): 3522-3525
27. Bewley S, Cooper D, Campbell S. Doppler investigation of uteroplacental blood flow resistance in the second trimester: a screening study of or pre-eclampsia and intrauterine growth retardation. Br J Obstet Gynaecol 1991; 98: 871-879.
 28. Saigal S, Shrivastava JR. Foeto-pacental weight relationship in normal pregnancy and pre-eclampsia-eclampsia- a comparative study. Indian paediatrics. 1970;7(2):68-77.
 29. Rath G, Garg K and Sood M. Insertion of umbilical cord on the placenta in hypertensive mother. J Anat Soc India. 2000;49(2):149-52.
 30. Liliana S. Voto, Alicia M. Lapidus, Effect of preeclampsia on Mother, Fetus and Child. Originally published in review article in gynaecology Forum. 1999; 4 (1):12
 31. Udainia A, Jain M L. Morphological study of placenta in pregnancy induced hypertension with its clinical relevance. J Anat. Soc. India .2001; 50(1): 24-27.
 32. 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. 1996; 46(1): 40-46.
 33. Singh S, Gugapriya TS. A cross sectional morphometric study of hypertensive with normal placentae and its correlation with fetal outcome. Int J Anat Res 2014;2(2):437-42.
 34. Gupta C, harode HA, D'souza AS, Sharma A. A morphological and morphometric study of placenta with its clinical implications. Trop J Med Res 2015;18:85-8
 35. Majumdar S. Study of placenta in normal and hypertensive pregnancies. J Anat Soc India 2005;54:34-8.
 36. Kurdukar MD, Deshpande NM, Shete SS, Zawar MP. Placenta in PIH. Indian J Pathol Microbiol 2007;50:493-7.

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