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Morphometric and Morphological Study of Human Placenta in Hypertensive Females of West U. P. India

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ABSTRACT

Background: During pregnancy the placental mass maintains a dynamic relationship with the weight of developing fetus. Hypertensive disorders of pregnancy are strongly associated with fetal growth restriction, prematurity, contributing largely to perinatal mortality & morbidity. Objectives: A study of 120 placenta was done to find out morphometry & morphological changes of placenta of hypertensive mother in comparison to those of mother with uncomplicatedpregnancies. **Methods:** This study was carried out on sixty mothers with normal pregnancy and sixty mothers with hypertensive pregnancies. **Results:** Hypertensive pregnancies are associated with changes in morphometry and morphology ofplacenta including placental weight, diameter, thickness, surface area, volume, number of cotyledons all are decreased in hypertensive placenta. Fetoplacental ratio increases in hypertensive groups. **Conclusion:** Hypertensive disorders of pregnancy adversely influence the morphology of placenta as well as they effect perinatal outcome.

Keywords: Cotyledons, Hypertensive, Morphometric, Placenta.

INTRODUCTION

The placenta is a unique organ which is attached to the uterus and is connected to fetus through umbilical cord. The placenta provides the physiological exchange between the maternal and fetal circulation.

The human placenta is usually discoid in its shape. At term 1/5th part of placenta is of maternal origin consisting of decidua basalis and 4/5th part of placenta is of fetal origin, whichdevelops from chorionic frondosum. Placenta has fetal and maternal surfaces and peripheral margins.[1]

Incidence of hypertensive disorder of pregnancy is high in developing countries with malnutrition, hypoproteinemia& poor obstetric facilities. Approximately one half of hypertensive disorders in pregnancy are caused by chronic hypertension and remainder due to pre-eclampsia and eclampsia. Pre-eclampsia andeclampsia aremultifaceted hypertensive disorder of pregnancy affecting several organs in body. Pre-eclampsia and eclampsia are not separate disorder but differentiated according to their clinical symptoms.

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The diagnosis is based on three clinical signs: pregnancy induced hypertension, proteinuria and edema.[2] Severe deterioration marked by organ dysfunction and development of convulsion then it is called eclampsia. Pre-eclampsia is defined as gestational blood pressure elevation with proteinuria that develops after 20 wks of gestation. Criteria for the diagnosis of pre-eclampsia is systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm Hg and protein urea of 0.3 gm or more in a 24-hr urine specimen. When convulsion occurs the condition is referred to as eclampsia.[3]

Adverse effects of hypertension on the placenta have been studied in various national and international researches, carried out in different global regions. Previous studies have reported the effect of hypertensive disorders during pregnancy on the morphology of placenta (like decreased placental weight, volume, diameter and surface area, thickness and changes of shape etc.[4-8] The present study is directed to correlate whether there is any difference between placenta of hypertensive group and placenta of control group (uncomplicated pregnancy).

MATERIALS AND METHODS

Samples were collected from Indoor patient department (IPD) of Department of Obstetrics and

Gynecology and studied in the Department of Anatomy FH Medical College & Hospital, Tundla, Dist- Firozabad, Uttar Pradesh. Sixty mothers with uncomplicated pregnancy and sixty mothers with pregnancy with hypertensive disorders were selected from Indoor patient department (IPD) of Department of Obstetrics and Gynecology of F. H. Medical College & Hospital Tundla, Dist- Firozabad, Uttar Pradesh. Inclusion criteria for hypertensive groups includes:-age of mothers ranged from 21 to 35 years, Primipara, Gestational hypertension, Preeclampsia, Eclampsia.

Exclusion criteria for control and hypertensive group includes : Multipara, History of any other present or past illness, History of any substances or drug abuse, Bad obstetric history Mothers with uncomplicated pregnancy were classified under "control" group and mothers with pregnancy with hypertensive disorders were classified under "hypertensive"group. Each group comprising sixty cases. In each group, mothers were examined for height, weight, vitals, anemia along with history of past illness & previous obstetrics history. Hypertensive group included mothers with diastolic blood pressure ≥ 90 mm Hg or systolic blood pressure ≥ 140 mm Hg. Blood pressure was noted everyday on at least three occasions 8 hours apart. After delivery fetuses were inspected for presence of any congenital anomaly. Their birth weight was taken in kilograms. Comparison of fetal weight was done in both control and hypertensive group using unpaired' test. After delivery all the placenta were collected in a clean tray. Insertion of umbilical cord & attachment of fetal membrane were noted down, and then membranes and cord were cut off. The placenta were gently squeezed to remove its extra blood content & then washed thoroughly under running tap water and wiped with a dry towel.

Following parameter were noted for morphometric and morphological comparison of placenta in each group-

- Placental Weight (in gms)
- Diameter (in cm)
- Thickness (in cm)
- Surface area of placenta (in square mm.)
- Volume of placenta (in cubic mm.)
- Number of cotyledons on maternal surface
- Feto- placental ratio
- Shape
- Presence of area of infarction and areas of fibrin deposition.

For measuring weight of placenta, firstly umbilical cord & membranes were cut off from placenta. Each placenta was squeezed gently to remove extra blood followed by washing and drying. A weighing scale with accuracy up to 10 grams was used for measuring the weight of placenta. For measuring the diameter & thickness of placenta digital Vernier caliper was used with accuracy up to 0.1 mm. Care was exercised to remove any "+ve" or "–ve" error by pressing "ABS" button of caliper before measurement. Diameters were taken in four planes as shown in figure-1 to derive mean diameter of each placenta.

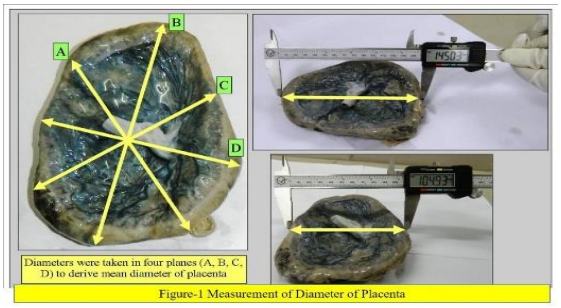


Figure-1 Measurement of Diameter of Placenta

Thickness of placenta was measured with the help of sliding rod of Vernier caliper. Sliding rod of caliper was pierced vertically in 4 quadrants and at the centre of placenta [Figure 2] All the readings were noted, followed by calculation of mean thickness ofeach placenta.

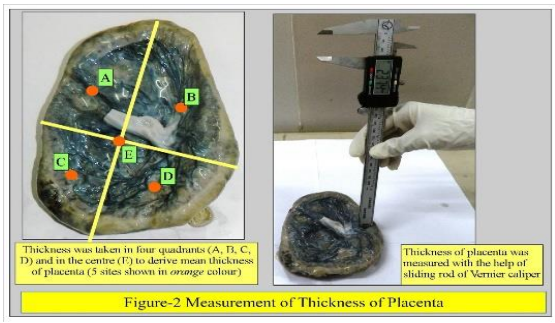
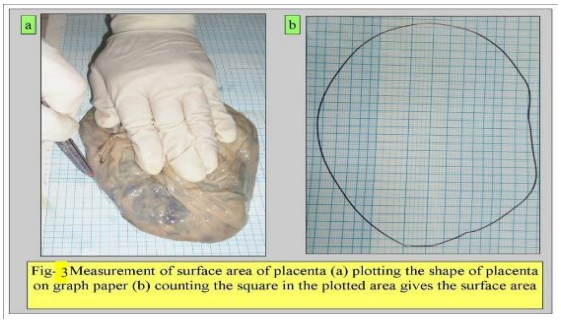


Figure-2 Measurement of Thickness of Placenta

Placental surface area was calculated with the help of standard graph paper having square of 1 mm². Placentae were placed on graph paper and its imprint is taken by drawing the line along the margin of placenta with the help of pencil. Placentae were removed from the paper and the squares were counted to measure the surface area of placenta in square mm. [Figure 3]



Volume of placenta is measured with the help of graduated jar of 5 liter. Jar is prefilled with water up to 2 liter mark. Placenta was dipped in this water. Then increase inthe level of water was calculated which represents the volume of placenta in cubic mm.

Each placenta was taken on both hands. Then gentle pressure was applied on the central part of the fetal surface with thumbs of both hands while holding the periphery of the placenta with the other fingers. As a result, the cotyledons on the maternal aspect become prominent after separation between them. Then the placenta was put on a flat tray with maternal side facing upward by placing a block of paraffin on the fetal side. Then counting was started from the left side of the one end of theplacenta going rightward and again turning back to the left in a manner of loop. This counting procedure was repeated until the other end of the placenta was reached. The total number of cotyledons was recorded. Mean number of cotyledon per placenta were also calculated for each group. (Kishwara et al, 2009) [Figure 4]

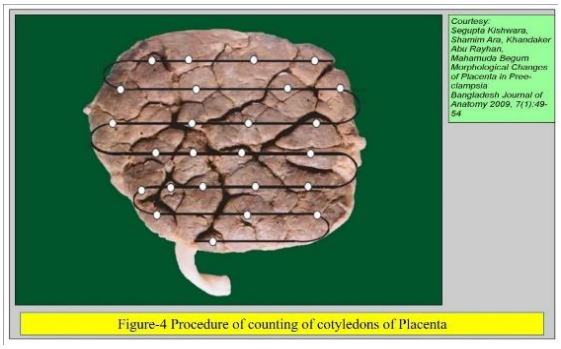


Figure-4 Procedure of counting of cotyledons of Placenta

Feto-placental weight ratio was calculated by following formula-

F.P. ratio = fetal weight / placental weight

Keen observation of each placentae was done to note its shape. Shapes were categorized as discoidal (circular/rounded and oval/elliptical) and irregular (lobed, bilobed, membranaceous or diffuse and other shapes etc).

RESULTS

Table 1: Placental & Fetal Morphometric & Morphological Study

Parameters	Control group Mean ± SD	Hypertensive group Mean ± SD	p value
Fetal weight in Kg.	3 ± 0.37	2.55 ± 0.47	<.001
Placental weight in gms.	506 ± 27	390 ± 88.1	<.001
Placental thickness cm.	2.43 ± 0.37	2 ± 0.41	<.001
Placental surface sqcm.	2.53 ± 26.01	170.86 ± 31.2	<.001
Placental vol. cubic mm	516 ± 62.18	355 ± 81.82	<.001
Mean number of cotyledos	16.4 ± 1.81	12.3 ± 1.6	<.001

60 mothers with uncomplicated pregnancy and 60 mothers with pregnancy with hypertensive disorders were selected from Indoor patient department (IPD) of Department of Obstetrics and Gynecology of FH medical college & hospital Agra, Uttar Pradesh. Mothers with uncomplicated pregnancy were classified under "control" group and mothers with pregnancy with hypertensive disorders were classified under "hypertensive" group. Each group comprising 60 cases.

Mean fetal weight significantly decreases in hypertensive group (2.55 ± 0.47) than the control group (3 ± 0.47). The mean placental weight, placental thickness, placental surface area, placental volume, mean number of cotyledons significantly decreases in hypertensive group as compare to control group. (p <.001)

Table 2: Mean Feto-Placental Ratio

Control Group			Hypertensive Group		
Neonatal Weight (Kg)	Placentaweight (Gms)	Feto-Placental Ratio	Neonatal Weight	Placental Weight	Feto-Placental Ratio
3 ± 0.37	506 ± 27	5.96 ± 0.82	2.55 ± 0.47	390 ± 8882.1	6.7 ±1.13

On comparison of mean feto-placental ratio between control and hypertensive group with unpaired t-test, a significant higher value was found in hypertensive group then control group. (p<0.02)

Table 3: Placental Shape

Shapes	Control group (n=60)		Hypertensive group (n=60)	
	Number	Percentage	Number	Percentage
Discoidal	54	90	52	86.7
Circular	10	16.6	04	6.6
Oval	44	73.3	48	80
Irregular	06	10	08	13.3

Table 4: Gross Changes In Placenta

	Number of subjects	Fibrin deposition	
		Present	Absent
Control group	60	4	56
Hypertensive group	60	18	42

	Number of subjects	Fibrin deposition	
		Present	Absent
Control group	60	4	56
Hypertensive group	60	18	42

The above table shows that majority of placenta are discoidal in shape (90% and 86% in control and hypertensive group respectively), out of which oval shape predominates over circular shape in both control and hypertensive groups. Prevalence of oval shape placentae is 73.3% and 80% in control and hypertensive group respectively, while

prevalence of circular shaped is 16.6 and 6.6% in control and hypertensive groups. Irregular shaped placentae were present only in 10% and 13.3% cases in control and hypertensive groups respectively.

Fibrin deposition were observed in 30 % cases in hypertensive group as compared to 6.66 % cases in control group, while infarcts were observed in 66.66% cases in hypertensive group as compared to 13.33 % in control group.

DISCUSSION

Present study revealed that the neonatal weight is significantly less in hypertensive group thancontrol group. In hypertension, arrangement of the intracotyledon vasculature is altered resulting in low birth weight of the babies.[9] As the severity of hypertension increases placental weight decreases and the incidence of intrauterine growth retardation raises leading to low neonatal birth weight. It is due to fact thatthere is relative decreased surface area fordiffusion in hypertensive placenta, leading to scarcity of nutrients essential for fetal growth culminating as decreased neonatal birth weight. The weight, diameter, thickness, surface area of placenta, volume, number of cotyledons on maternal surface significantly lower values in hypertensive group.

These finding corroborate well with that of the other studies.[5,6,8,10-14] The cause of reduction in blood flow is due to vasculopathies of the spiral arteries which in turn causes reduction in weight of placenta. The pre-eclamptic women have a lower mean gestation so one would also expect a lower proportion of fetal capillaries since the capillaries become larger as gestation proceeds. This relative increase infetal capillary volume (with decrease in proportion of connective tissue) leads to smaller volume parenchyma hence leadings to decrease in the placental weight.[15]

Table 5: Comparison Of Feto-Placental Ratio With Other Studies

S. No.	Study	Control Group	Hypertensive Group	Statistical Result
1	Majumdar S (2005)	5.89 ± 10.04	6.23 ± .87	Significant
2	Al-Mamori et al (2010)	4.89 ± .63	5.48 ± .24	p<0.001
3	Londhe et al (2011)	6.79±2.04	7.23 ± 1.90	p<0.01
4	Saeed et al (2011)	6.03 ± 0.04	7.27 ± 0.09	p<0.001
5	Nag U et al (2013)	5.94 ± 0.86	6.02 ± 0.36	P<0.05
6	Our study	5.96 ± 0.82	6.70 ± 1.13	p<0.02

Decreased diameter, thickness, surface area and volume in hypertensive placenta occur as a result of maternal vascular under perfusion primarily or it might be because of multiple infarcts or as a result of massive peri villous fibrin deposition secondarily.

Feto-placental ratio

On comparison of mean feto-placental ratio between control and hypertensive group with unpaired t-test, a significant increase was found in hypertensive group than control group.(p<0.02) [Table 2]

Fetoplacental ratio also found higher , though their finding were not significant.[16,17] Reduction of fetal weight was far less than the reduction of placental weight that is why there is relative increase in fetal placental ratio in hypertensive group.[18]

Placental shape

In the present study, majority of placenta were discoidal in shape (90% and 86% in control and hypertensive group respectively), out of which oval shape predominated over circular shape in both control and hypertensive groups.[Table 3] Prevalence of oval shape placentae was 73.3% and 80% in control and hypertensive group respectively, while prevalence of circular shaped was 16.6 and 6.6% in control and hypertensive groups.[Table 3] Irregular shaped placentae were present only in 10% and 13.3% cases in control and hypertensive groups.[Table 3]

Table 6: Comparison Of Placental Shapes With Other Studies

S. no.	Study	Control group				Hypertensive group			
		Discoid	Circular	Oval	Irregular	Discoid	Circular	Oval	Irregular
1	Kishwara et al (2009)	76.6	43.3	33.3	23.3	73.3	33.3	40	26.7
2	Navbir P (2012)	83.3			16.7*	73.3			26.7*
3	Dadhich (2012)**	80	56	24	20	82	32	50	18
4	Present Study		10	44	06		04	48	8

*bidiscoidal, diffuse, lobed placenta were considered under irregular shapes

**chronic hypertensive group and eclamptic group in their study were added for comparison

In the previous studies,[4,5,19] it is observed that discoidal shape placenta is more prevalent over irregular shaped placenta in control as well as hypertensive groups.[Table 6] In the study of amongst the discoidal placenta,[5,19] circular shaped

placenta were most common type seen in control group and oval placenta were most common type shape found in hypertensive group.[Table 6]

Contrary to their finding in the present study oval shape predominates (amongst the discoi-dal variant) in both the control and hypertensive group. The pathogenesis of shape variation is not completely understood yet, but these anomalies probably reflect a failure or disturbance in the pattern of orderly villous atrophy and proliferation, that generally results in a single circular or oval placental disc with transition to fetal membranes at the disk edge.[20] Fibrin deposition were observed in 30 % cases in hypertensive group as compared to 6.66 % cases in control group, while infarcts were observed in 66.66 % cases in hypertensive group as compared to 13.33 % in control group.

Placental infarcts are the most common and conspicuous lesions observed. Infarcts are firm; condensed dead areas of villous tissue that often encompass the entire thickness of the placenta. Frequently, they involve the base of the placenta and are particularly common at the placental edge. They represent villous tissue that has diedbecause of deficient intervillous (maternal) circulation.[21]

Perivillous fibrin deposits are regular finding in the normal term placenta. Fibrin routinely deposits around stem villi being grossly visible as lacelike strands. Massive perivillous fibrin deposition refers to very large macroscopically visible accumulation of perivillous fibrin that appears hard and waxy, pale, tan or grey, may range from 1-2 to several cms. in size. This deposition represents a pathologic process in which large group of villi becomes encaged in wide bands of dense fibrin like material.[20]

CONCLUSION

Hypertensive disorders of pregnancy adversely influence the morphology of placenta as well as they effect perinatal outcome. Placental weight, diameter, thickness, area, volume and number of cotyledons show a decrease in hypertensive group because of maternal vascular under-perfusion mainly.

Malperfusion of placenta in hypertensive mothers leads to poor growth of placenta; hence surface area for feto- maternal diffusion also diminishes leading to a poor fetal growth and intrauterine growth restriction causing decreased neonatal weight in hypertensive group. Feto-placental ratio increases in hypertensive groups because there is relatively less decrease in fetal weight than the placental weight. Among placental shapes, oval shaped placenta show increased prevalence in hypertensive group, this shape anomaly reflect a failure or disturbance in the pattern of orderly villous atrophy and proliferation that usually results in a single circular or oval placental disc with transition to fetal membranes at the disc edge.

Gross changes in placenta include massive placental infarcts and peri villous fibrin deposition etc. show marked increase in hypertensive group.

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