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Effect of Pregnency Induced Hypertension on the Morphometry of Placenta and Weight of New Born

Venkata surya kumar, Anusha rani, Antony selvin de'souza, prakesh babu
Department of Anatomy, Manipal University, Centre for Basic Sciences, Kasturba Medical College,manipal - 576104, India.

I. Introduction

Pregnancy induced hypertension is one of the threatening problem and complication arising from it are also common which lead to several maternal and foetal death. During pregnancy, examination of mother and foetus done properly but what is overlooked is placenta, as it cannot be measured directly until after birth. Foetal distress, intrauterine foetal death and placental abnormalities are common in pregnancy induced hypertension. Rate of preterm birth range from 5 to10 percent of deliveries in developing countries (HslehT'Sang-T'Sang 2005). About two third of preterm deliveries are due to spontaneous onset of preterm labour or preterm premature rupture of membranes.

Aims and objectives

1) To study the gross anatomy and morphometry of placentae with normal pregnancy.
2) To study morphology of placentae in pregnancy induced hypertension and its effect on foetus.
3) To compare morphometry of placentae of pregnancy induced hypertension patients with that of normal.
4) To establish the correlation of placental weight with weight of newborn baby.
5) To compare the finding of present study with those of previous studies.
6) To study its clinical relevance.

II. Material And Method

Cases selected are those patients who were having blood pressure 140/90mm of Hg or more with or without oedema/proteinuria. None of these cases had hypertension prior to pregnancy.

In control group, pregnancies with normal blood pressure and without oedema/proteinuria were included. Only placentae from 36 to 40 weeks of pregnancy were included in this study because of their easy availability, and because cases of premature termination before this time are associated with abnormal pregnancy, so that it is then difficult to form a control group. Only cases with live births were included.

Two hundred and one placentae, 101 from normal pregnancies and 100 from pregnancy induced hypertension pregnancies, were examined..

Material Used: -

1) Weighing machine.
2) Measuring scale.
3) Strip of graph paper.
4) Vernier calliper.
5) Magnifying lens.
6) Probe.
7) Permanent marker.
8) Plastic tag.
9) Scissor.
10) Scalpel.
11) Forcep.

Method:- The baby's weight was recorded on the weighing scale.In the department of Anatomy, umbilical cord was tied and cut leaving 2.5 cm attached to the foetal surface of placenta. Then the placenta was washed thoroughly under tap water, clots if any present were removed from maternal surface after proper examination and recording, and then placenta was gently blotted dry with the filter paper.

The placentae were examined carefully for following parameters. (Benirschke K. 1961, J. F. Yetter 1998, Rath G.et al. 2000)

1) Completeness of placentae.
2) Shape of placentae.
3) Calcification.
4) Retroplacental haematoma.
5) Site of attachment of umbilical cord to placentae.
6) Thickness of placentae.
7) Number of cotyledon.
8) Circumference of placentae.
9) Minimum distance of attachment of umbilical cord.
10) Weight of placenta.
11) Number of blood vessel in umbilical cord.
12) Weight of the new born.

1) Completeness of placentae :

Foetal surface, maternal surface and membranes were examined carefully to see completeness of placenta. Incomplete placentae were discarded and not included in the study.

2) Number of blood vessels in umbilical cord

The cut end of umbilical cord was observed by using hand lens and number of umbilical arteries and veins were noted.

3) Shape of placenta :

By placing placenta on flat surface its shape noted.

4) Calcification :

Both the foetal and the maternal surfaces of placenta were observed for calcification.

5) Retroplacental haematoma :

The maternal surface of placenta was observed to detect evidence of retroplacental haematoma.

6) Number of cotyledons :

The maternal surface of placenta was observed to count number of cotyledons.

7) Thickness of placenta :

Thickness of placenta was measured at its centre. The placenta was kept on a hard surface such as wooden table, in such a way that its maternal surface is in contact with the surface of the table. Then a sharp probe was pierced at the centre of the foetal surface until it touches the surface of the table. Now, the point up to which the probe was inserted was marked. Then the distance between the tip of the probe and the marked point was measured by using vernier calliper in mm.

8) Circumference of placenta:

Circumference of placentae was measured by using strips of graph paper.

Two centimetre broad strips of graph paper were wrapped round the margin of placenta and the point of overlapping of two ends was marked on the graph paper. Then the strip of graph paper was made straight and the circumference was calculated in mm.

9) Minimum distance of attachment of umbilical cord to placenta:

Minimum distance of insertion of umbilical cord on placenta was calculated in mm by using sliding vernier calliper.The minimum distance between the site of insertion and the margin of the placenta was measured and denoted as ʻdʼ.

10) Site of attachment of umbilical cord to placenta:

For site of attachment of umbilical cord first insertion percentage calculated.It is calculated as follows. The minimum distance between the site of insertion and margin of placenta was denoted as ʻdʼ the radius ʻrʼ was calculated from the circumference. By using following formula insertion percentage was calculated-

The insertion percentage = d/r ×100

From the insertion percentage, placentae were grouped into-
1) Marginal placenta where insertion percentage is from 0 to 25.
2) Lateral eccentric placenta where insertion percentage is from 26 to50.
3) Medial eccentric placenta where insertion percentage is 51 to75.
4) Central placenta where insertion percentage is above 76.

11) Weight of placenta
Weight of placenta was taken in gram by using standard weighing machine after removing membranes and cutting cord leaving 2.5 cm attachment.

12) Weight of newborn baby
Weight of new born baby was taken on standard weighing machine immediately after cord tying and cutting.

III. Results

Study included 201 placentae which were grouped into normal (101 placentae), and pregnancy induced hypertension (100 placentae).Each placenta was then examined carefully and studied by using following parameters-

Table No. 1: Showing presence of calcification on placentae in normal and PIH (pregnancy induced hypertension) group.

Calcification	Normal (%)	PIH (%)	Total
Yes	28 (27.7%)	34 (34%)	62
No	73 (72.3%)	66 (66%)	139
Total	101 (100%)	100 (100%)	201

Chi-square value = 0.928 p value =0.335

In the present study, the numbers of placentae with calcification, from normal group are 28 and placentae from PIH group are 34. In normal group 27.7% placentae are showing calcification while in PIH group 34% placentae are showing calcification.Though the placentae in PIH group show higher frequency of calcification, the difference is statistically insignificant

Table No.2: Showing presence of retro-placental Haematoma on placentae in normal and (pregnancy inducedhypertension) PIHgroup.

Retro-placental haematoma	Normal (%)	PIH (%)	Total
No	99 (98%)	81 (81%)	180
Yes	2 (2%)	19 (19%)	21
Total	101	100	201

Chi-square value=15.557 p value< 0.001

In present study only two placentae from normal cases show presence of retro-placental haematoma (2%), while it is present in 19 placentae from PIH group (19%).Retro-placental haematoma is more in cases of PIH than the normal .The findings are highly significant.

Table No.3: Showing mean of Number of cotyledons on placentae from normal and (pregnancy inducedhypertension) PIH group.

Group	Normal	PIH
Number of placentae	101	100
Mean of Number of cotyledons	18.54	17.12
SD	2.780	2.993

P value<0.001

In the present study the mean of number of cotyledons on placentae of normal group is 18.54 and in placentae from PIH cases it is 17.12.The Number of cotyledons on placentae in normal group is more than PIH group. The difference in the means is statistically significant.

Table No. 4: showing mean thickness (in mm) of placentae from normal and (pregnancy inducedhypertension) PIH group.

Groups	Normal	PIH
Number of placentae	101	100
Mean thickness (mm)	31.7	22.83
SD	3.334	3.885

P value<0.001

Above table shows that the mean thickness in normal placentae is 31.7 mm where as in cases of PIH placentae the mean thickness is 22.83mm.Mean thickness of placentae in PIH is significantly lesser than the mean thickness of normal placentae.

Table No. 5: showing mean circumference (in mm) of placentae from normal and PIH (pregnancy inducedhypertension) group.

Groups	Normal	PIH
Number of placentae	101	100
Mean circumference (mm)	451.12	411.99
SD	37.024	36.175

P value<0.001

Above table shows that the mean circumference in placentae of PIH cases is 411.99 mm, while it is 451.12 in placentae of normal group.The mean circumference in PIH group is lesser than the normal group. The finding is statistically significant.

Table No. 6: showing mean minimum distance of insertion of umbilical cord on surface of placenta (in mm) in normal and (pregnancy inducedhypertension) PIH group.

Group	Normal	PIH
Number of placentae	101	100
Mean minimum distance of insertion of umbilical cord on placenta (mm)	43.99	35.56
SD	5.056	4.049

P value<0.001

In the present study the mean minimum distance of insertion of umbilical cord on surface of normal placentae is 43.99 mm and in placentae from PIH cases it is 35.56mm.The minimum distance of insertion of umbilical cord on surface of placenta in normal cases is more than PIH cases. The difference in the means is statistically highly significant.

Table No.7: Showing number of marginal, eccentric (medial, lateral) and central insertion of umbilical cord in normal and (pregnancy inducedhypertension) PIH groups.

Group	No.of placentae	Marginal insertion (0-25)	Lateral insertion (26-50)	Medial insertion (51-75)	Central insertion (76-100)
Normal	101	0	8	86	7
PIH	100	0	37	60	3

Above table shows insertion of umbilical cord on placentae where out of 101 placentae from normal group 86 are medial insertion 7 central and 8 with lateral insertion. In PIH out of 100 placentae, 37 with lateral insertion, 60 medial insertion while 3 are centrally inserted.

Table No.8: Showing mean weight (in gm) of placentae of normal group and (pregnancy inducedhypertension) PIH groups.

Groups	Normal	PIH
Number of placenta	101	100
Mean weight of placentae (gm)	469.50	420.98
SD	48.541	68.070

P value<0.001

Above table shows that the mean weight in normal placentae is 469.50gm, while in PIH placentae it is 420.98gm. The table shows that the mean weight of placentae in PIH is lower than the normal placentae and findings are statistically significant.

Table No.9: showing mean birth weight from patients whose placentae was examined i.e. from normal and (pregnancy inducedhypertension) PIH group.

Groups	Normal	PIH
Number of patients whose baby's birth weight measured	101	100
Mean birth weight (gm)	2556.93	2192.50
SD	363.389	410.923

P value=<0.001

Above table showing mean birth weight from patients whose placentae was examined i.e. from normal is 2556.93gm, while that from PIH is 2192.50gm.

It shows that the mean birth weight in PIH pregnancies is lower than the normal pregnancie and findings are statistically significant.

Table No.10: Mean of ratio between birth weight and placental weight in normal and (pregnancy inducedhypertension) PIH groups

Groups	Normal	PIH
Number	101	100
Mean of ratio birth weight/weight of placenta	5.465	5.212
SD	0.7103	0.5359

P value=0.005

The table shows mean of ratio between birth weight and placental weight in normal group is 5.465; in PIH group is 5.212 and findings are statistically significant.

Table No.11: Pearson's correlation coefficient (r) between birth weight and weight of placenta

	'r' value	'p' value
Normal	0.484	0.000
PIH	0.836	0.000

Both coefficients (r and p) are positive and significant.and shows that the correlation between birth weight and weight of placenta in normal is moderate whereas in PIH is strong.

Table No.12: Percentage of shapes i.e. circular and oval in normal and (pregnancy inducedhypertension) PIH groups.

		GROUP		Total
SHAPE	TOTAL	Normal	PIH	
Circular	Number	52	54	106
	%	51.5%	54.0%	52.7%
Oval	Number	49	46	95
	%	48.5%	46.0%	47.3%
	Number	101	100	201
	%	100.0%	100.0%	100.0%

P value>0.05

Above table show number of circular placenta in normal is 52 (51.5%), and in PIH it is 54 (54%). Number of oval placenta in normal is 49 (48.5%), and in PIH it is 46 (46%).Findings are not statistically significant.

Number of blood vessels in umbilical cord

In present study in normal placentae as well as in PIH group placentae that is in total 201 placentae two arteries and one vein observed.

Foetal surface

The colour of the foetal surface was grey blue in all the placentae. There were no abnormalities of foetal surface vessels.

IV. Discussion

The human placenta is a flattened discoidal mass with an approximately circular or oval outline. It has an average weight of 470 g, an average diameter of 185mm, and an average thickness of 23mm (range 10-40mm) .Thickest at its centre, it rapidly thins towards its periphery where it continues as the chorion leave. Macroscopically the foetal or inner surface, covered by amnion is smooth, shiny and transparent, so that the mottled appearance of the subjacent chorion, to which it is closely applied, can be seen. The maternal surface of the placenta is finely granular and mapped into some 15-30 lobes by a series of fissures or grooves. The lobes are often somewhat loosely termed cotyledons (Susan Standringet al.2005).

Placenta is an important vital organ of perinatal life. Despite of its important role in foetal development, study of placenta has lagged behind that of the foetus. The present study is carried out on placentae from normal healthy mothers and placentae from pregnancy induced hypertension (PIH). In the present study, 101 placentae from normal group and 100 placentae from pregnancy induced hypertension group are studied by using various metrical parameters as already mentioned. The metrical data was compared between normal and pregnancy induced hypertension group by using statistical methods. The findings of the present study compared with to those of the previous workers.

Table No.1: showing incidence of calcification in normal placentae in present and previous studies.

Different workers	No.of cases studied	No. Of placentae showing calcification	Percentage of calcification
H.Fox (1963)	195	48	24.6
Mr. D. K. Dutta and Mrs.B. Dutta (1989)	32	04	12.5
Present study (2009)	101	28	27.7

In the present study (2009), 28(27.7) of placentae from normal group are showing calcification.By observing above table it is found that our study correlates with previous worker.

Table No.2:showing incidence of calcification in placentae from pregnancy induced hypertension in present and previous studies.

Different workers	No.of cases studied	No.of placentae showing calcification	Percentage of calcification
H.Fox (1963)	92	06	6.6
Mr. D. K. Dutta and Mrs.B. Dutta (1989)	59	26	48
Present study (2009)	100	34	34

In the present study, 34 (34%) placentae from pregnancy induced hypertension group are showing calcification.Mr. D. K. Dutta and Mrs B. Dutta found 26 (48%) placentae from pregnancy induced hypertension group out of 59 cases studied. While H.Fox (1963) studied 92 cases out of that 6 (6.6%) placentae showing calcification, and he observed that the incidence of calcification is lesser in pregnancy induced hypertension than normal group. He explained that he included cases who deliver before 38 weeks of pregnancy and because of this the incidence of calcification in pregnancy induced hypertension group is lesser than the normal.Findings of our study correlate with other workers.

Table No.3: showing incidence of retroplacental haematoma in pregnancy induced hypertension in present and previous studies.

Different workers	No. of placentae	No.of placentae showing retroplacental haematoma	Percentage
Carlos Alberto Salvatore (1968)	112	32	28.5
Ernest W. Page (1972)	160	10	6.2
D.K. Dutta and Mrs.B.Dutta (1989)	59	18	30.7
SavitaSodhi (1990)	20	02	10
Present study (2009)	100	19	19

Incidence of retroplacental haematoma in pregnancy induced hypertension group is (19%) higher than the normal group (2%).

Data from Ernest W. Page (1972) observed 0.8 % retroplacental haematoma in normal group, while 6.2 % in preeclampsia group.

Our findings correlated with finding of previous workers and statistically significant so it suggest that incidence of retroplacental haematoma is higher in pregnancy induced hypertension group than normal.

Number of cotyledons in normal and pregnancy induced hypertension groups

In the present study we observed mean of number of cotyledons in normal group 18.54 while in pregnancy induced hypertension mean is 17.12.

In the study done by Majumdar S et al. Observed mean number of cotyledons per placenta is 17+2 in control group and 16+2 in hypertensive they found lower value in hypertensive group but statistically not significant. We also observed lower value in pregnancy induced hypertension (17.12) than normal group (18.54) Even though our value is statistically significant it is not clinically that much significant.

Thickness of placenta

In the present study it is observed that the mean thickness of placentae in pregnancy induced hypertension (22.83mm) is significantly lesser than the thickness of normal placentae (31.7mm).

A G. Rangnekar and RashmiDarbari (1993) who observed that in case of anaemia, placenta becomes thinner than the normal. In our study it is observed that the placentae from pregnancy induced hypertension group are thinner than the normal group. The findings are statistically significant.

Mean circumference in placentae of normal and pregnancy induced hypertension (PIH)

In the present study, the mean placental circumference in cases of placenta with pregnancy induced hypertension is 411.99mm and the mean placental circumference observed in placentae of normal group is 451.12mm.

Therefore, the present study suggests that the mean placental circumference in cases of placenta with pregnancy induced hypertension is significantly lower than the mean placental circumference observed in placentae of normal group.

Minimum distance of insertion of umbilical cord on surface of placenta

It is observed that mean Minimum distance of insertion of umbilical cord on surface of normal group placentae is 43.99mm while in placentae from pregnancy induced hypertension it is 35.56mm.

So, the above findings show that the mean minimum distance of insertion of umbilical cord on placental surface significantly decreases in pregnancy induced hypertension.

Number of marginal, eccentric (medial, lateral) and central insertion of umbilical cord in normal and pregnancy induced hypertension.

In the present study insertion of umbilical cord on placentae where out of 101 placentae from normal group 86 are medial insertion, 7 central and 8 with lateral insertion. In pregnancy induced hypertension out of 100 placentae, 37 with lateral insertion, 3 are centrally inserted.

In the present study pregnancy induced hypertension group placentae show more lateral insertion than normal group placentae. Our study does not observe marginal insertion it may be due to small sample size.

Table No.5: showing mean placental weight in normal group and pregnancy induced hypertension group (PIH) placentae in present and previous studies.

Different workers	Normal		PIH	
	No. of placentae	Mean placental weight (gm)	No.of placentae	Mean placental weight (gm)
A.P. Chakravorty (1967)	200	420	200	380
A.M.Thomson (1969)	-	630	-	596
Samuel Lurie et al. (1999)	431	613.0±123.8	-	-
Palaskar (2001)	-	475	-	392
UdainiaA;Jain M.L. . (2001)	25	495	75	405
Samin et al (2001)	300	537	-	-
Majumdar S et al. (2005)	50	485.85±47.31	50	399.10±90.31
Present study (2009)	101	469.50	100	420.98

In the present study, mean placental weight in normal group is 469.50 gm and in pregnancy induced hypertension group is 420.98 gm

It is observed that the mean placental weight is significantly low in placentae from pregnancy induced hypertension group as compare to normal group.

Findings of the present study correlated with those of the previous studies.

Udainia A; Jain M.L (2001) observed maximum weight of placenta in control group was 700gm and minimum weight of placenta in it 250gm. In pregnancy induced hypertension they found maximum weight of placenta 650gm while minimum weight 200 gm.

In present study, the maximum weight of placenta in control group is 600gm and minimum weight of placenta in it is 380gm. In pregnancy induced hypertension our study found maximum weight of placenta 550gm while minimum weight 250 gm.

Table no.6: showing mean birth weight in normal group and pregnancy induced hypertension group (PIH) placentae in present and previous studies.

Different workers	Normal		PIH	
	Number of cases	Mean birth weight (gm)	Number of cases	Mean birth weight (gm)
A.P. Chakravorty (1967)	-	2805	-	-
Thomson (1969)	-	3167	-	2832
Palaskar (2001)	-	2990	-	2368
UdainiaA;Jain M.L. . (2001)	25	2640	75	-
Majumdar S et al. (2005)	50	2800±0.32	50	2040±0.48
present study (2009)	101	2556.93	100	2192.50

Thomson (1967) observed that birthweights were lower in cases of preeclampsia.

Majumdar et al. observed that foetal weight is significantly less in the hypertensive group.

In present study the birth weight is significantly lower in pregnancy induced hypertension group than normal group. Findings of present study correlated with previous study.

The difference in the mean of birth weight in different workers may be due to the various factors, which affect the birth weight such as socioeconomic status, races, nutrition of mother etc.

Mean of ratio between birth weight and placental weight in normal and pregnancy induced hypertension.

Luis A. Cibils (1973) observed mean of ratio between birth weight and placental weight in normal was 5.20±0.76, Samuel lurie (1999) observed it was 5.6±0.96, RathG,GargK,andSood M. Found it as 7.11, Majumdar observed it was 5.89±10.04.In present study it is 5.465 in normal.Our study correlated with previous study.In present study, mean of ratio between birth weight and placental weight in pregnancy induced hypertension is5.212, Majumdaretal.observed it was 6.23±0.87 while Luis A.Cibils found it as 5.22±0.74. Majumdar et al found high value of ratio in pregnancy induced hypertension than normal. Luis A. Cibils found it was not significant. Thomson et al. (1969) found that mean of ratio between birth weight and placental weight in pregnancy induced hypertension is less than normal group. A.P.Chacravorty also found similar findings; present study corresponds to these findings.

Correlation between birth weight and placental weight in normal and pregnancy induced hypertension.

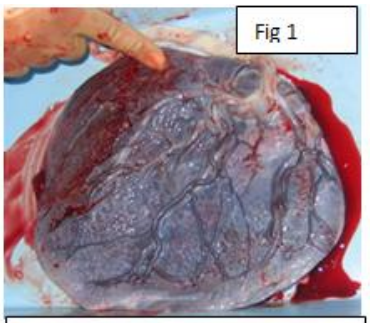
In present study birth weight and weight of placenta in normal is moderately correlated (r=0.484), while in pregnancy induced hypertension it is strongly correlated(r=0.836).Thomson et al. (1969) found that placental weight and birth weights were moderately correlated (r=0.5-0.6). Janthanaphan M et al. (2006) studied 238 normal pregnancies, between the 36^{th}-40^{th} gestational week their study observed that placental weight significantly related with birth weight (r=0.450).So findings of present study correlated with studies of previous workers.

Number of blood vessels in umbilical cord

In present study in all the 201 cases, there were two umbilical arteries and one umbilical vein. R.SinanKaradeniz et al. (2001) studied 259 placentae and umbilical cord, in most of the cases,there were two umbilical arteries and one umbilical vein. In two cases (0.8%), the artery was single.Geoffrey Altshuler, A James Mcadams (1972) found 0.5% incidence of single umbilical artery in 2,215 consecutively examined placentas.As the sample size is less in this study (201) the incidence of single umbilical artery could not be predicted.

Shape of the placenta

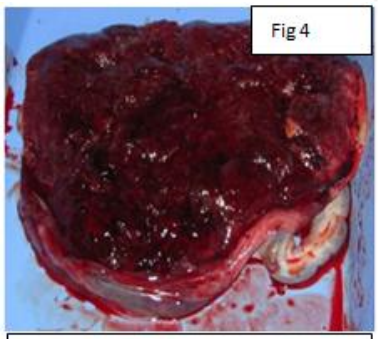
In present study we found in normal there were 52 (51.5%) circular placenta and in pregnancy induced hypertension it was 54(54%), number of oval placenta in normal was 49(48.5%), and in pregnancy induced hypertension it was 46 (46%).



Foetal surface of placenta

Circumference of placenta

Thickness of placenta



Maternal surface of placenta

Bibliography

[1]. BeischerN.A.,SivasambooR.,VohraS. and Stanley Reid (1970): Placental hypertrophy in severe pregnancy anaemia.J.of Obstet.Gynec.Brit.Comm.wealth.Vol.77:398-409.

[2]. Brosens I. Renaer M. (1972): On the pathogenesis of placental infarcts in pre-eclampsia.J.obstet.Gynaec.Brit.Cwlth.79:794-799.

[3]. Browne JCM, Veall N. (1953): the maternal blood flow in normotensive and hypertensive women.JObst. Gynaecol of British Empire, 60:141-147

[4]. Carolyn M. Salafia, Elizabeth Maas, John M.Thorp, Barbara Eucker, John C Pezzullo and David A. Savitz (2005): Measures of placental growth in relation to birth weight and gestational age. American J. Of epidemiology 160(10):991-998.

[5]. ChakravortyA.P. (1967): Foetal and placental weight changes in normal pregnancy and pre-eclapsia.J.obstet.Gynaec.Brit.Cwlth.74:247-253.

[6]. DuttaD.K. and Mrs.DuttaB. (1989): Study of human placentae associated with preeclampsia and essential hypertension in relation to foetal outcome. J. of Obstet. and Gynec. Of India. 39(6):757-763

[7]. Fox, H (1964): calcification of the placenta.J.Obstet. Gynaec. Brit. Cwlth, 71(2):759-765.

[8]. KabirN, KawserC A, RhamanF, KabirM L, RahamanA: The relationship of placental weight with birth weight.MMJ.01/08/200708/2007;16 (2):177-80.

[9]. Kaizad R. Damania, Vinita S. Salvi, Shyam K.Ratnaparkhi and Shirish N.Daftary (1989):The placenta in hypertensive disorders of pregnancy.J.of Obstet.and Gynaec.of India.OL.39:28-31.

[10]. Luis A. Cibils, M.D (1974): The placenta and newborn infant in hypertensive conditions.J.Obstetrics and Gynecology. 118(2):256-267.

[11]. Majumdar S, Dasgupta H, Bhattacharya K, Bhattacharya A (2005): A study of placenta in normal and hypertensive pregnancies. J.Anat.Soc.India 54 (2) 1-9.

[12]. Palaskar A, Choudhary KR and Mayadeo NM (2001):Foeto placental weight relationship in normal pregnancy &pre-eclampsiaeclampsia Bombay Hospital J. 43(3): 361-3.

[13]. ThomsonA. M., BillewiczW. Z.,HyttenF. E. (1969): The weight of the placenta in relation to birth weight. J.of Obstet.Gynec.Brit.Comm.wealth.76(10):865-872.

[14]. Udainia, A; Jain,M.L (2001):Morphological study of placenta in pregnancy induced hypertension with its clinical relevance. J. Anatomical society of India 50 (1) 24-27 (2001).

[15]. Udainia A, Bhagwat SS, Mehta CD (2004-01-2004-06):relation between placental surface area, infarction and foetal distress in pregnancy induced hypertension with its clinical relevance 53(1).