Original Article

Hypertensive Pregnancy

Morphological and Histological Changes in Placenta of Hypertensive and Gestational Diabetic Women

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ABSTRACT

Objective: To correlate the morphological and histo-pathological changes in placenta observed in normal, diabetic and hypertensive pregnancies.

Study Design: A cross sectional study

Place and Duration of Study: This study was carried at the department of Gynae and Obs Taluka hospital Hala, and Basic health unit Hala from 1st January, 2014 to 30th June, 2014

Materials and Methods: For this experimental study statistical analysis was carried on SPSS-11.0 version. Total 90 cases studied were divided in three equal groups. All placentae were processed through stages for final histo-pathological examination.

Results: The study showed that discoid shape were significantly less 4(13.3%) in hypertensive as compared to 16 (53.3%) diabetic and normal placentae ($p<0.01$), bilobed in 6 (20.0%) diabetic placenta. In hypertensive placenta 15(50%) had central attachment of umbilical cord, diabetic 22 (73.3%) and normal 30(100%). Central thickness (Mean ± S.D ± SEM) of hypertensive placenta 2.2 ± 0.58 ± 0.11 were significantly less ($p<0.01$) as compared to normal placenta 3.0 ± 0.03 ± 0.01 but diabetic placenta 3.8 ± 1.15 ± 0.21 were significantly high ($p<0.01$) as compared to hypertensive and normal placenta.

Conclusion: Gestational diabetes and hypertension had significant t-test that causes morphological changes in placenta that affects fetal and maternal wellbeing. This study is helpful for those who are concerned for mother and child health.

Key Words: Hypertension, Diabetes, Pregnancy, Placenta

INTRODUCTION

The trophoblast of human placenta is directly exposed to the maternal circulation. It forms the main barrier to maternal–foetal glucose transport. The present study investigated the effect of sustained hyperglycemia in vitro on the glucose transport system of these cells.[1] Preeclampsia is a major contributor to the maternal and neonatal mortality and morbidity.[2] It is the 2nd largest cause of maternal mortality worldwide and affects 5% to 7% of pregnant women worldwide.[3]

The results of this study suggest that, in Class C diabetics, placental morphology and placental function are probably not more adversely affected than in other less severe forms of the disease during pregnancy.[4] Every year around 585,000 women die from complications of pregnancy and child birth, and more than 99% of these deaths occur in less developed regions.[5] Globally it is estimated that 12% of all maternal deaths are related to the hypertensive disorders of pregnancy.[6] Maternal mortality ratio in Pakistan is higher than in many parts of the world and maternal health indicators have shown little sign of improvement over the last few decades.[7] Hypertension is a global epidemic of general population and pregnancy is no exception to this rule.[8] The hypertensive disorders complicating pregnancy include fetal distress, intrauterine fetal death and placental abnormalities.[9] Pregnancy induced hypertension is associated with macroscopic and microscopic changes in the placental structure.[10] Hypertension in pregnancy intensifies morphological changes of aging in placenta and subsequently effecting outcome of pregnancy including fetal distress, growth retardation and fetal death.[11] The resulting ischemia causes fetal hypoxia, which may lead to fetal distress and death. In recent years, it has been revealed that there is clear relationship between morbid histological changes of placentae of hypertensive mothers and fetal growth retardation.[12] At term human placenta is flattened mass with approximately circular or oval outline, but the shape is determined by the form of patch of villi finally left on chorionic sac.[13] Metabolic diseases associated with pregnancy, like hypertension and diabetes are highly common in low socioeconomic groups. During the first half of pregnancy, the placenta not only increases its surface area but reaches its maximum. This accompanies increase in size, length and complexity of branching of villous stems.[14]

In gestational diabetes, when metabolic control is good, perinatal mortality should be no higher than in the general population.[15] Foetal hyper-insulinemia is the cause of macrosomia. Even mild disturbances of maternal carbohydrate metabolism can lead to foetal

hyperinsulinemia. Within the chronic hypertensive disease, the most common diagnosis is essential vascular hypertension.[16]

MATERIALS AND METHODS

Data Collection Procedures: This study was carried at the department of Gynae and Obs Taluka hospital Hala, and Basic health unit Hala old cases were examined and identified for diabetes and hypertension during pregnancy for the parameters mentioned successively.

The gross feature noted for placentae from each group includes shape, diameter, surface area, weight, cotyledons, central thickness and attachment of umbilical cord. Placentae from all groups were studied microscopically for average number of syncytial knots per unit area, amount of chorionic villous collagen, trophoblastic basement membrane thickness, tissue processing for sectioning and staining.

Paraffin Sections: Placentae fixed in 10% formalin were processed for routine paraffin embedment. Sections were cut and mounted on clean gelatinized slides, stained with H&E, Mallory's trichrome, and methenamine silver.

Micrometry: A stage micrometer was used for calibration of ocular micrometer and the counting reticule.

The samples divided into three groups

Group A: This group comprises of 30 placentas from pregnancies, which will not be suffering from any disease, and will be served as control.

Group B: This group comprises of 30 full term placentae from mothers suffering from hypertension.

Group C: This group comprises of 30 full term placentae from mothers suffering from diabetes.

Ethical Consideration: The written informed consent was taken from the patients, consultant and hospital administration of Taluka Hospital Hala and Basic Health Unit Hala old.

Inclusion and Exclusion Criteria:

- For this study only mature placenta were taken, Premature and Post mature placenta were not considered in this study.
- Only diabetic placentae were closely monitored.
- Also hypertensive placentae were taken without any other complications.
- These placentae were preserved in 10% formalin after half hour after the delivery.

Statistical Analysis: The data feeding and analysis was on computer package SPSS (Statistical Packages of Social Sciences) version 11.0

RESULTS

Total 90 placentae, 30 from normal, 30 each from hypertensive and diabetic were observed. The study showed that shape discoid were significantly less 4(13.3%) in hypertensive as compared to 16 (53.3%) diabetic placenta and normal placenta ($p<0.01$), bilobed in 6 (20.0%) diabetic placenta. In hypertensive placenta 15(50%) were central attachment of umbilical cord, diabetic 22 (73.3%) and normal 30(100%). Out of 30 cases of hypertensive placenta, 20 (66.7%) showed increased syncytial epithelial knots as compared to diabetic 9 (30.0%) $p<0.01$ (table 1)

Table No.1: Morphological changes between Normal (Group A) and Hypertensive (Group B) and Diabetic (Group C) placenta

	Group A		Group B		Group C		B vs. C
	Normal placenta (n=30)		Hypertensive placenta (n=30)		Diabetic placenta (n=30)		
	No.	%	No.	%	No.	%	P-value
Shape							
Discoid	30	100.0	4	13.3**	16	53.3	0.001
Small discoid	-		19	63.3	-		-
Star discoid	-		7	23.3	8	26.7	0.765
Bilobed discoid	-		-		6	20.0	-
Site of attachment of Umbilical cord							
Acentric	30	100.0	15	50.0	22	73.3	0.063
Marginal	-		15	50.0	8	26.7	0.063
Hemorr-hage	-		16	53.3	17	56.7	0.795
Infarction	-		16	53.3	18	60.0	0.602
Villous edema	-		18	60.0	22	73.3	0.273
Hypervascularity							
Decreased	-		16	53.3**	6	20.0	0.007
Increased	-		9	30.0	15	50.0	0.113
No	30	100.0	5	16.7	9	30.0	0.222
Syncytial Epithelial knots	-		20	66.7**	9	30.0	0.004

Statistically significant ** p<0.01

Table No.2: Comparison of Central thickness (cm), Diameter (cm) and Weight (gm) between Normal (Group A) and hypertensive (Group B) placenta

	Group A	Group B	P-value
	Normal placenta (n=30)	Hypertensive placenta (n=30)	
	Mean ± S.D ± SEM	Mean ± S.D ± SEM	
Central thickness (cm)	3.0 ± 0.03 ± 0.01	2.2 ± 0.58 ± 0.11**	0.001
Diameter (cm)	21.1 ± 3.37 ± 0.62	19.5 ± 5.10 ± 0.93	0.534
Weight (gm)	557.8 ± 33.85 ± 6.18	524.4 ± 154.7 ± 28.24	0.948

Statistically significant ** p<0.01

Results for Table 2, 3, and 4: Central thickness (Mean ± S.D ± SEM) of hypertensive placenta 2.2 ± 0.58 ± 0.11 were significantly less ($p<0.01$) as compared to normal

placenta 3.0 ± 0.03 ± 0.01 (Table 2) but diabetic placenta 3.8 ± 1.15 ± 0.21 were significantly high ($p<0.01$) as compared hypertensive and normal placenta (Table 3 & 4)

In diabetic placenta (Mean ± S.D ± SEM) of diameter 34.5 ± 7.93 ± 1.45 and weight 1478.8 ± 699.6 ± 127.7 were significantly ($p<0.01$) high as compared to normal placenta diameter 21.1 ± 3.37 ± 0.62, weight 557.8 ± 33.85 ± 6.18 (Table 3) and hypertensive placenta diameter 19.5 ± 5.10 ± 0.93), weight 524.4 ± 154.7 ± 28.24 (Table 4)

Table No.3: Comparison of Central thickness (cm), Diameter (cm) and Weight (gm) between Normal (Group A) and Diabetic (Group C) placenta

	Group A Normal placenta (n=30)	Group C Diabetic placenta (n=30)	
	Mean ± S.D ± SEM	Mean ± S.D ± SEM	P-value
Central thickness (cm)	3.0 ± 0.03 ± 0.01	3.8 ± 1.15 ± 0.21**	0.001
Diameter (cm)	21.1 ± 3.37 ± 0.62	34.5 ± 7.93 ± 1.45 **	0.001
Weight (gm)	557.8 ± 33.85 ± 6.18	1478.8 ± 699.6 ± 127.7 **	0.001

Statistically significant ** p<0.01

Table No.4: Comparison of Central thickness (cm), Diameter (cm) and Weight (gm) between Hypertensive (Group B) and Diabetic (Group C) placenta

	Group B Hypertensive placenta (n=30)	Group C Diabetic placenta (n=30)	
	Mean ± S.D ± SEM	Mean ± S.D ± SEM	P-value
Central thickness (cm)	2.2 ± 0.58 ± 0.11	3.8 ± 1.15 ± 0.21**	0.001
Diameter (cm)	19.5 ± 5.10 ± 0.93	34.5 ± 7.93 ± 1.45 **	0.001
Weight (gm)	524.4 ± 154.7 ± 28.24	1478.8 ± 699.6 ± 127.7 **	0.001

Statistically significant ** p<0.01

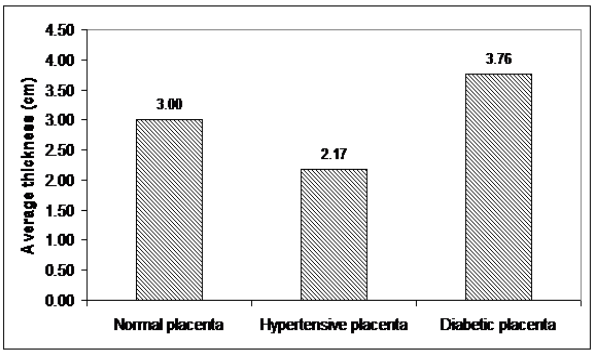


Figure No.1: Comparison of average thickness (cm) between normal, hypertensive and diabetic placentae

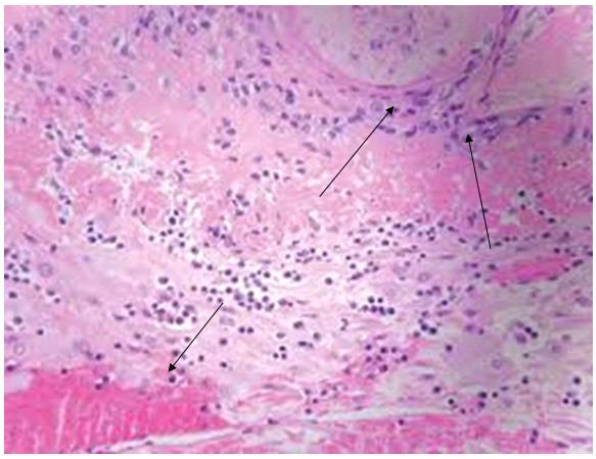


Figure No.1: Photomicrographs 5: Showing hypervascularity in diabetic placental tissue with masons trichome staining at 10× magnification/IPF

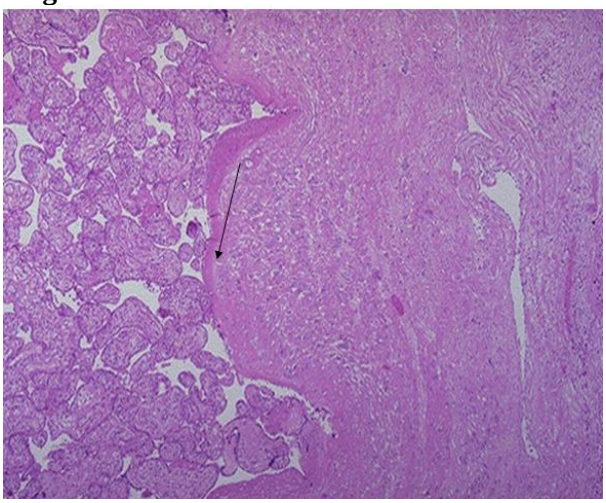


Figure No.2: Photomicrographs 6: Showing villous adema in diabetic placenta staining withg H and E at 10x magnifaication / IPF

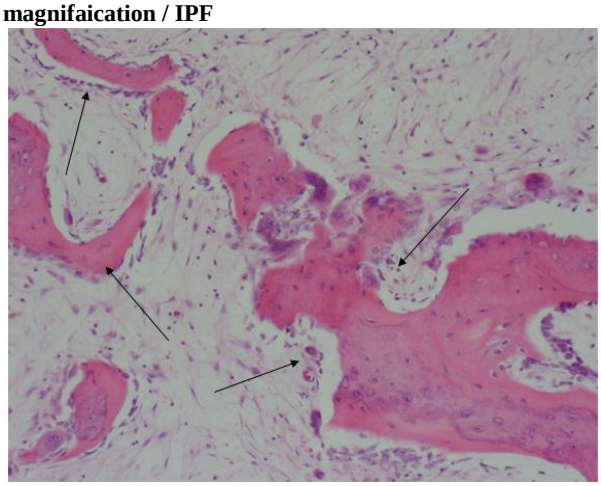


Figure No.3: Photomicrographs 7: Showing villous edema in hypertensive placental tissue at 10 × magnification/IPF with H and E staining

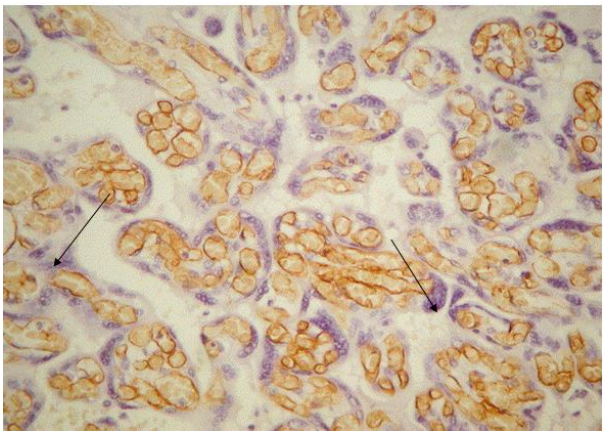


Figure No.4: Photomicrographs 8: Showing infarction in hypertensive placental tissue masons trichome staining at 10× magnification/IPF

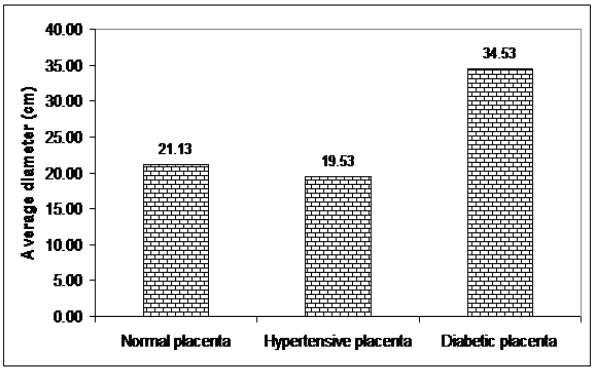
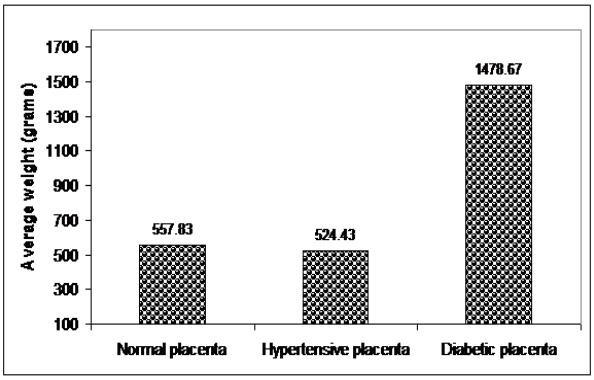


Figure No.2: Comparison of average diameter (cm) between normal, hypertensi diabetic placentae

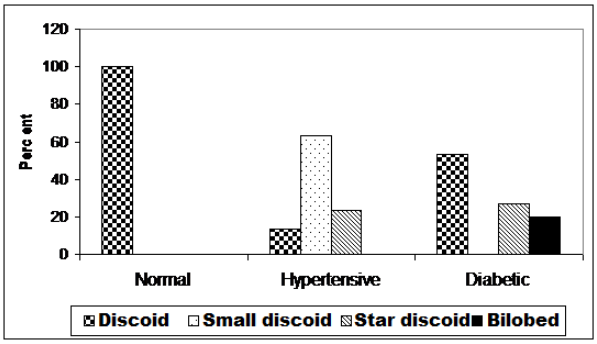


Normal placentae Hypertensive placentae Diabetic placentae

Figure No.3: Comparison of average weight (grams) between normal, hypertensive and diabetic placenta

DISCUSSION

Out of 30 cases of hypertensive placenta, 20 (66.7%) showed increased syncytial epithelial knots as compared to diabetic 9 (30.0%) p<0.01. Central thickness (Mean ± S.D ± SEM) of hypertensive placenta 2.2 ± 0.58 ± 0.11 were significantly less (p<0.01) as compared to normal placenta 3.0 ± 0.03 ± 0.0, but diabetic placenta 3.8 ± 1.15 ± 0.21 were significantly high (p<0.01) as compared hypertensive and normal placenta. In diabetic placenta (Mean ± S.D ± SEM) of diameter 34.5 ± 7.93 ± 1.45 and weight 1478.8 ± 699.6 ± 127.7 were significantly (p<0.01) high as compared to normal placenta diameter 21.1 ± 3.37 ± 0.62, weight 557.8 ± 33.85 ± 6.18 and hypertensive placenta diameter 19.5 ± 5.10 ± 0.93), weight 524.4 ± 154.7 ± 28.24.



Normal placentae Hypertensive placentae Diabetic placentae

Figure No.4: Comparison of shape and size between normal, hypertensive and diabetic placentae

Our results correlate with the study of (Rahman H et al., 2006). To observe vascular changes in the placenta, a study was carried out on 44 placentas19 from overt diabetic mothers having no hypertension and 5 from hypertensive diabetic mothers, and 20 from control group having no hypertension or diabetes. In our research In diabetic placenta (Mean ± S.D ± SEM) of diameter 34.5 ± 7.93 ± 1.45 and weight 1478.8 ± 699.6 ± 127.7 were significantly (p<0.01) high as compared to normal placenta diameter 21.1 ± 3.37 ± 0.62, weight 557.8 ± 33.85 ± 6.18 and hypertensive placenta diameter 19.5 ± 5.10 ± 0.93), weight 524.4 ± 154.7 ± 28.24.[17]

This study matched with the study of (kovo M et al. 2010) Pregnancy-induced hypertension/preeclampsia (PIH) and foetal growth restriction (FGR) share a common placental origin Maternal vascular lesions were more common in the PIH group and combined group (61% and 59%, respectively), compared with the FGR group (16.2%; P < .001), and villous lesions were more common in the combined group, compared with the FGR and PIH groups (79.5%, 53.5%, and 46.9%, respectively; P = .004 Present study showed Out of 30 cases of hypertensive placenta, 20 (66.7%) showed increased syncytial epithelial knots as compared to diabetic 9 (30.0%) p<0.01. Central thickness (Mean ± S.D ± SEM) of hypertensive placenta 2.2 ± 0.58 ± 0.11 were significantly less (p<0.01) as compared to normal placenta 3.0 ± 0.03 ± 0.0.[18]

In the study of Marilza VCR et al.2011, changes seemed in HTN and DM plancetae include great variability of vascularity manifested by strikingly hypovascular as well as hypervascular terminal villi. In our study, hypervascularity of villi noted in 15 out of 30 diabetic patient placentae. In hypertensive group 30 placentae hypervascularity of villi were present in 9 (30%), in comparison with normal villi. Capillaries of hypo vascular villi had a smaller diameter and

displayed a markedly wavy course whereas in hypervascular villi numerous capillaries occurred in reduced stroma and often had a large diameter. This is true as we noted similar changes in our study.[19]

This study showed similarity with the (Guzmán-Gutiérrez E et al., 2011) Endothelial damage and reduced metabolism of the vasodilator adenosine occur and foetal hyper insulinemia associated with deficient insulin response and a metabolic rather than mitogenic phenotype is characteristic of this pathology. These phenomena lead to endothelial dysfunction of the foeto placental unit. In diabetic placenta (Mean ± S.D ± SEM) of diameter 34.5 ± 7.93 ± 1.45 and weight 1478.8 ± 699.6 ± 127.7 were significantly ($p<0.01$) high as compared to normal placenta diameter 21.1 ± 3.37 ± 0.62, weight 557.8 ± 33.85 ± 6.18.[20]

This study correlates with the (Stansly JL et al., 2011) Endothelial dysfunction has been observed systemically in women with gestational diabetes (GDM). The effects of GDM, however, on uterine artery function and the possible mechanisms that mediate endothelial dysfunction remain unknown.[21]

CONCLUSION

Gestational diabetes and hypertension causes significant morphological changes in placenta that affects fetal and maternal wellbeing. This study is helpful for those who are concerned for mother and child health.

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