ORIGINAL ARTICLE

Fibrinoid Necrosis and Hyalinization Observed in Normal, Diabetic and Hypertensive Placentae

Farrah Shams[1], Muhammad Rafique[1], Nawaz Ali Samoo[2] and Raheel Irfan[1]

ABSTRACT

Objective: To determine the fibrinoid necrosis and hyalinization extent in placenta observed in normal, diabetic and hypertensive pregnancies.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Institute of Basic Medical Sciences, Dow University of Health Sciences, Karachi, from 2008-2010.

Methodology: One hundred and fifty placentae were divided in three groups on the basis of their histories and clinical examination. Group A (control), Group B (Diabetic) and Group C (Hypertensive), each consisted of 50 samples. The samples were transferred to Dow Diagnostic Reference and Research Laboratory for histopathology and gross examination. The tissue samples were taken from different sites, processed and routine staining done. The slides were then examined under light microscope for hyalinization and fibrinoid necrosis. The data was analyzed by applying ANOVA and post-hoc Tukey at 95% confidence interval. Mean ± standard deviations (SD) were computed.

Results: The mean number of hyalinized villi in control group was 0.54 ± 0.908, 1.18 ± 1.9540 in the diabetic group and 2.14 ± 1.863 in the hypertensive group. The difference in their average turned out to be statistically significant (p-value < 0.001). Mean number of villi having fibrinoid necrosis was statistically significant in both the diabetic and hypertensive groups as compared to the control group i.e. 13.98 vs. 4.02 and 10.08 vs. 4.02 respectively (p-value < 0.001).

Conclusion: There was significantly greater fibrinoid necrosis and hyalinization in placentae from mothers having diabetes and hypertension. The fibrinoid necrosis was seen more in diabetic group as compared to hypertensive and control, while hyalinization was observed more frequently in hypertensive group as compared to the other groups. Placental changes as seen in examination of delivered placentae will be helpful in preventing the adverse effects in successive pregnancies.

Key words: *Fibrinoid necrosis. Hyalinization. Diabetes mellitus. Hypertension. Placenta.*

INTRODUCTION

Placenta is a vital organ for fetal development, formed from fetal membranes and endometrium, it is basically meant for exchange of nutrients between maternal and fetal circulation to ensure an optimal environment for fetal growth and development. Placental examination is of critical value as it can be used in gathering knowledge about management conducted during pregnancy, identification of etiologies and pathological process contributing to the adverse outcome of pregnancy and improving management in subsequent pregnancies.[1] Gestational and established diabetes and hypertension specifically cause more destruction to placental structure and altering its function as a consequence of structural changes in placental architecture. They have been seen as major contributors to insufficiency of placenta and damage of its morphological appearance, which is vital for bringing oxygen and nutrients to fetus and removing carbon dioxide and waste.[2,3] The significance of examining placenta in correlating the cause is never ruled out. Though advances have occurred in this field, it has been found that 92% placentae sent for examination by the obstetricians and neonatologists have relevant pathology.[4] It has been suggested that placental examination is of critical importance in neonatal-perinatal care and placentae should be sent for histopathology if there is a maternal or neonatal illness that requires medical care. Essentially, if maternal illness is significant one such as gestational diabetes and hypertension that can be harmful in successive pregnancies as well.[5] Though it has a short life span, placenta is in constant state of morphological flux. It is the fastest growing organ of human body. It grows from a single cell to approximately 5 x 10^{10} cells in 38 weeks.[6] Its histological appearance alters profoundly during gestational period. It is derived from both fetal and maternal tissues, the maternal portion being the decidua basalis and the fetal portion being the chorion frondosum.[7]

[1] *Department of Anatomy, Dow University of Health Sciences (DUHS), Karachi.*

[2] *Department of Neurosurgery, Jinnah Postgraduate Medical Centre (JPMC), Karachi.*

Correspondence: Dr. Farrah Shams, House No. 24/II/II, 2nd Gizri Street, Phase IV, DHA, Karachi.
E-mail: drfarrahshams@hotmail.com

Received April 14, 2011; accepted July 06, 2012.

The objective of this study was to determine the fibrinoid necrosis and hyalinization extent in placenta observed in normal, diabetic and hypertensive pregnancies.

METHODOLOGY

A cross-sectional comparative study was carried out at the Department of Anatomy, Institute of Basic Medical Sciences (IBMS) and Dow Diagnostic Research and Reference Laboratory, Dow University of Health Sciences (DDRRL/DUHS), from October 2008 to June 2010. The study was approved by IRB of DUHS. The samples were collected from the patients; two hospitals were selected for this purpose, National Medical Centre Kalapul, Karachi and Jinnah Postgraduate Medical Centre, Ward-9, Karachi. The population of interest in this study was human placentae delivered after singleton delivery from normal, hypertensive and diabetic ladies.

Non-probability, purposive sampling was done. The patients were identified and selected through OPDs, on the basis of their histories and clinical examination. They were spaced in different groups. A total number of samples collected were 150. The samples were divided into three groups; normal (A), diabetic (B), and hypertensive (C). Each group comprised of 50 placentae. Full term placentae (37 – 40 weeks gestation) were included; while those below 36 weeks (premature) and above 40 weeks (postmature) of gestation were excluded from the study for diabetic placentae, co-morbid conditions such as hypertension, viral infection etc. in mother was ruled out. Similarly, hypertensive group was ensured not to have any other complication. Placentae from extreme maternal age that is < 17 or > 42 years were also excluded from this study. Only those placentae were sent for histopathology which was preserved within 40 minutes of delivery in formalin containing jars. Informed consent was taken from the consultants, hospitals and patients.

After delivery the placenta along with cord and membranes was weighed, and preserved in formalin containing plastic jars within 40 minutes of delivery so as to avoid any ultra structural changes. The specimen was labeled with the patient's name, hospital ID #, disease group, and weight of placenta. The samples (placentae) were transferred to Dow Diagnostic Reference and Research Laboratory for histopathology and gross examination.

The microscopic examinations of placentae was done for which tissues were taken from different sites including the centre of placenta, 12'clock margin of placenta, 6'clock margin of placenta, junction of cord with placenta, and any other abnormal area. The tissues were kept in cassettes with proper labelling; processed and routine staining was done with H and E stain. The slides were then tagged and arranged and later examined under light microscope for hyalinization and fibrinoid necrosis. The total number of hyalinized villi were counted from three different fields of each slide (total 4 – 5 slides per sample). Similarly, number of villi showing fibrinoid necrosis were counted from three different fields of each slide (total 4 – 5 slides per sample).

Statistical Package for Social Sciences (SPSS) was used to analyze the data. Frequency, mean ± standard deviation of values were computed by using one-way ANOVA for comparison between all the three study groups for both variables. Post-hoc Tukey HSD[a] was applied for pairwise comparison between diabetic and controls and hypertensive and controls. The significance level was considered as $p \leq 0.05$ at 95% confidence interval (CI).

RESULTS

Mean number of hyalinized villi at per low power field (LPF) at 10 x magnifications in group A, B and C are shown in Table I. Tissues were observed under light microscope for histopathological changes and photomicrographs were taken as shown in Figure 1 and 2. The mean number of hyalinized villi found in placenta in groups A, B and C was 0.54 ± 0.908, 1.18 ± 1.954 and 2.14 ± 1.863 respectively. Comparing the number of hyalinized villi in groups A, B and C had statistically significant ($p < 0.001$) higher number of hyalinized villi.

Mean fibrinoid necrosis found in villi at per low power field at 10 x magnification in all groups were observed and recorded as shown in Table I. Microphotographs are

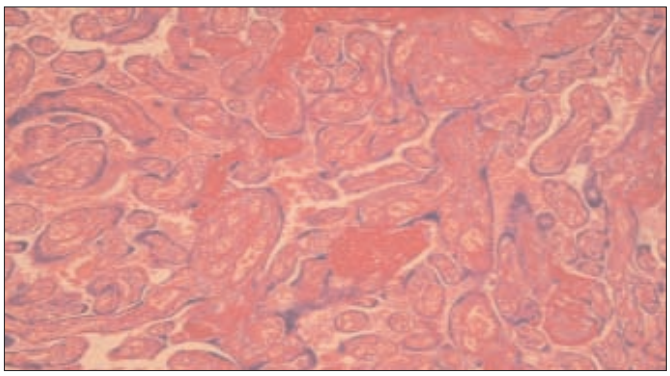

Figure 1: Photomicrograph of 5 μm thick section of normal placenta under low power magnification showing no hyalinization and minimal fibrinoid necrosis with H & E staining.

Table I: Mean ± SD of number of hyalinization and fibrinoid necrosis of villi of placentae per low power field in different groups.

Group	Normal (A)	CI	Diabetic (B)	CI	Hypertensive ©	CI	p-value
No. of hyalinized villi /lpf	0.54 ± 0.908[ab]	95%	1.18 ± 1.945[b]	95%	2.14 ± 1.863[c]	95%	< 0.001
No. of villi showing fibrinoid necrosis /lpf	4.02 ± 3.000[a]	95%	13.98 ± 5.374[b]	95%	10.08 ± 3.288[c]	95%	< 0.001

** a, b and c shows the significance of difference between the groups after the pair wise comparison is done between individual groups applying post hoc Tukey HSD$_a$. If any two or more groups have same letters than it shows that they are insignificant or having no difference between them.*

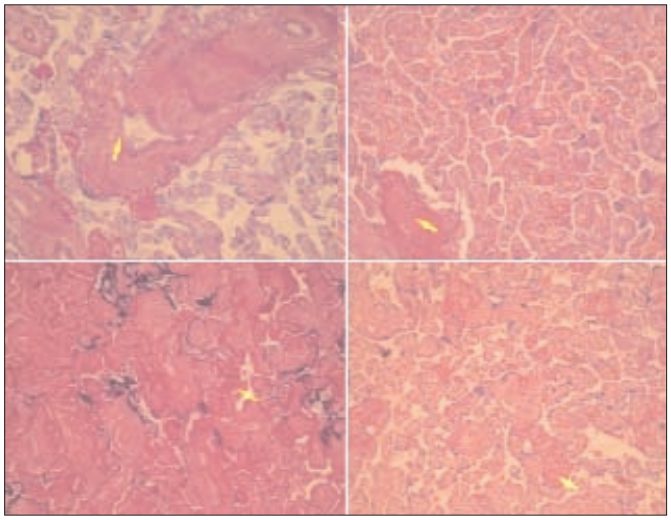

Figure 2: Photomicrograph of 5 μm thick section of hypertensive placentae (above) and diabetic placenta (below) under low power magnification showing hyalinization of villi on left and fibrinoid necrosis on right with H & E staining.

shown in Figure 1 and 2. Mean foci of fibrinoid necrosis found in villi in groups A, B and C were 4.02, 13.98 and 10.08 respectively. While mean foci of fibrinoid necrosis found in villi in group A was compared with group B and group C there was statistically significant ($p < 0.001$) greater fibrinoid necrosis found.

Hyalinization of villi was comparatively more in diabetic and hypertensive groups when compared to controls and the results are statistically significant, while the readings were highest in hypertensive group. Fibrinoid necrosis was more in diabetic and hypertensive groups when compared to normal but the findings were more pronounced among diabetics.

DISCUSSION

Complications of pregnancy like hypertension and gestational diabetes are reflected in the placenta in a significant way both macroscopically and micro-scopically. Postdelivery examination of placenta provides much insight into the pre-natal health of the baby and mother.[8]

In this study, statistical significance was seen in hypertensive, diabetic and control group. There was a difference in the amount of hyalinized villi between hypertensive, diabetic and control groups, but this difference was not statistically significant between diabetic and controls. Microscopically the villi gave a ghosty disrupted appearance of the villus wall. The presence of hyalinized villi is in agreement with Majumdar and co-workers.[8] Significant increase in number of fibrinoid necrosis in villi, hyalinized villous space is seen comparatively more in hypertensive groups.[8] Placental morphological changes indicate maternal disease.[9] Placentae from pregnancies complicated by hypertensive disorders showed endovascular plugs until third trimester, possibly contributing to the ischaemic changes and damage to the placental tissue.[10]

This study has also shown a high association between the study groups and diseases in respect to fibrinoid necrosis, which is increased in diabetes and hypertension when compared to normal. Microscopically the villus showed larger size with homogenous material filled inside and minimal vasculature. The villi appear large and immature showing fibrinoid necrosis.[11] With direct light microscopy there were fibrin thrombi, villous oedema, hyperplasia and thickening of basement membrane in placentae of poorly controlled diabetic mothers along with this various changes in structure of syncytio-trophoblast were seen by Al-Okail and co-workers.[12] Decidual necrosis and fibrinoid necrosis was also reported by Ian and co-workers. All these changes occurred despite the good glycemic control.[13] A recent study highlighted some differences in diabetic mother than non-diabetic like villous fibrinoid necrosis.[14] Placenta from diabetic pregnancies is characterized by fibrinoid necrosis.[15] Placentae of diabetic mothers showed excessive fibrinoid necrosis on microscopy.[10] Placenta from diabetic pregnancies is characterized by villous immaturity, choriangiosis, and fibrinoid necrosis rather than ischaemic changes but if diabetes was appropriately controlled and treated, the findings may be normal.[16]

Fibrin deposits were also found greater in hypertensive placentae and they presented a large number of villi vessels. Fibrin deposits increase in placental tissue in peri-villous region in pregnancy induced hypertension as reported earlier.[17] Placental study in pregnancies complicated by these conditions, can lead to significant reduction in unwanted or poor pregnancy outcome and will specifically help both obstetricians and paediatricians to adopt a proper line of management in such conditions.[18] Placenta is an essential organ for exchange of nutrients and metabolites between mother and fetus.[19] Increased villous collagen and increased thickness of sub-trophoblastic basement membrane lead to increased thickening of placental barrier between fetal and maternal blood which in turn reduce the exchange of materials across placenta.[20] This study is in agreement with previous work done.

Electron microscopy or molecular level studies could not be carried out due to limited resources and budget. In our region previously only morphometric studies have been carried out on placentas, while the facts obtained from this study will be helpful for the obstetric and paediatric practitioners to gather the local figures.

CONCLUSION

There was significantly greater fibrinoid necrosis and hyalinization in placentae from mothers having diabetes and hypertension. The fibrinoid necrosis was seen more in diabetic group as compared to hypertensive and control, while hyalinization was observed more frequently

in hypertensive group as compared to the other groups. Placental changes as seen in examination of delivered placentae will be helpful in preventing the adverse effects in successive pregnancies.

REFERENCES

1. Chang KT. Pathological examination of the placenta: raison d'etre, clinical relevance and medico legal utility. *Singapore Med J* 2009; **50**:1123-33.
2. Udiania A, Bhagwat S, Mehta CD. Relation between placental surface area, infarction and fetal distress in pregnancy induced hypertension with its clinical relevance. *J Anat Soc India* 2004; **53**:27-30.
3. Nelson SM, Freeman DJ, Sattar N, Lindsay RS. Role of adiponectin in matching of fetal and placental weight in mothers with type-I diabetes. *Diabetes Care* 2008; **31**:1123-5.
4. Altshuler G, Hyde S. Clinicopathologic implications of placental pathology. *Clin Obstet Gynecol* 1996; **39**:549-70.
5. Jonathan MD, Carolyn S. The role of placental examination in the diagnosis and treatment of neonatal illness. *Placenta* 2000; **3**:1-3.
6. Nikkels PG. Placenta pathology associated with maturation abnormalities and late intrauterine fetal death. *Placenta* 2006; **10**:293-9.
7. Harold Fox, Neil J, editors. Pathology of the placenta. 3rd ed. Philadelphia: *Elsevier Saunders;* 2007.
8. Majumdar S, Dasgupta H, Bhattacharya K, Bhattacharya A. A study of placenta in normal and hypertensive pregnancies. *J Anat Soc India* 2005; **54**:1-9.
9. Oliveira LH, Xavier CC, Lana AMA. Alteracoes morfologicas placentarias de recem-nascidos pequenos para a idade gestational. *J Pediatr* 2002; **78**:397-402.
10. Kos M, Czernobilsky B, Hlupic L, Kunjko K. Pathological changes in placenta from pregnancies with eclampsia and pre-eclampsia with emphasis on persistence of endovascular trophoblastic plugs. *Croat Med J* 2005; **46**:404-9.
11. Margaret JE. Diabetes and pregnancy: a review of pathology. *Br J Diabetes Vasc Dis* 2009; **9**:201-6.
12. Al-Okail MS, Al-Attas OS. Histopathological changes in placental syncytiotrophoblasts of poorly controlled gestational diabetic patients: *Endocr J* 1994; **41**:355-60.
13. Ian WC, Catriona D, Rennie U, Margaret E. Placental dysfunction and still birth in gestational diabetes mellitus: *Br J Diabetes Vasc Dis* 2009; **9**:38-40.
14. Alvarez H, Medrano CV, Sala MA, Benedetti WL. Trophoblast development gradient and its relationship to placental haemodynamic, study of fetal cotyledons from the toxemic placenta. *Am J Obstet Gynecol* 1972; **114**:873-8.
15. Makhseed MA, Ahmed MA, Musini VM. Impaired gestational glucose tolerance. Its effect on placental pathology. *Saudi Med J* 2004; **25**:1241-4
16. Boyd PA, Scott A. Quantitative structural studies on human placentae associated with pre-eclampsia, essential hypertension and intrauterine growth retardation. *Br J Obstet Gynaecol* 1985; **92**:714-21.
17. Rosana RM, Correa RRM, Gilio DB, Camila L. Placental morphometrical and histopathological changes in different clinical presentations of hypertensive syndromes in pregnancy. *Arch Gyneacol Obstet* 2008; **277***:*201-6.
18. Canterbury DH. Guideline of histological examination of placenta. Geneva: *WHO Women's and Children's Health;* 2009 .
19. Arey LB, editor. Developmental anatomy. 7th ed. Philadelphia: *WB Saunders.*1974.
20. Ashfaq M, Channa MA, Malik MA, Khan D. Morphological changes in human placenta of wet snuff users. *J Ayub Med Coll Abbottabad* 2008; **20**:110-3.