



HISTOMORPHOMETRIC STUDY OF UMBILICAL CORD IN HYPERTENSIVE PREGNANCY WITH DIFFERENT SEVERITY

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ABSTRACT

The primary function of umbilical cord is to supply blood to and from the placenta. Pregnancy induced hypertension is a unique disorder in human pregnancy appears after 20 weeks of gestation. Hypertension in pregnancy is associated with both maternal and fetal morbidity and mortality. The structure of umbilical vessels was purely depending on rate of blood flow through it. Aim of the present study to evaluate the histological changes of umbilical vessels in pregnancy induced hypertension with different severity. There were 4 groups in the study, Group 1 - Control group, Group 2 - Gestational hypertensive group, Group 3 - women with mild preeclampsia, Group 4 - severe preeclampsia. 1cm length of foetal end of cord were used for the histological study. Specimens were fixed in 10% formalin and sections were stained with H&E and Vangieson stains. Whartons jelly area and the size of umbilical vessels were reduced in hypertensive pregnancy. Among the hypertensive groups, very lowest values have been noticed in severe preeclampsia. The total thickness of umbilical vessels were more in severe preeclampsia, that was mainly due to the proliferation of smooth muscles in tunica media. The changes in structure of umbilical cord might be due to the altered hemodynamic condition in PIH. In accordance with the low blood flow and increased blood pressure, the umbilical vessels wall thickness also increased by the proliferation of smooth muscle cells in their media and the vessels were highly constricted.

KEY WORDS: preeclampsia, wharton's jelly, tunica intima, tunica media.

INTRODUCTION

The umbilical cord is an intra amniotic free floating structure fixed between the placenta and the foetus. Structurally, it consists of two arteries twisting around a single vein that are surrounded by Wharton's jelly, which is in turn encased by the amniotic epithelium. The primary function of umbilical cord is to supply blood to and from the placenta.

Hypertension is the common pathology related to pregnancy, occurs in 4-5% and it is the major cause of maternal and fetal mortality and morbidity.^[1,2] Pregnancy induced hypertension is a unique disorder in human pregnancy appears after 20 weeks of gestation. Preeclampsia starting as mild and it worsens to severe and finally transformed into eclampsia.^[3] Gestational hypertension is the preliminary condition before onset of true preeclampsia.

Hypertension in pregnancy is associated with both maternal and fetal morbidity and mortality. Fetal complication like IUGR, SGA, prematurity and still birth in severe cases.^[4] Umbilical cord does not have any nerve supply, so the structure of umbilical vessels was

purely depending on rate of blood flow through it.^[5] Previous study have been discussed the morphological changes of cord between normal and hypertensive group. Aim of the present study is to evaluate the histological changes of umbilical vessels in pregnancy induced hypertension with different severity.

Methodology: Institutional ethical committee has been approved the present study. Total numbers of 200 umbilical cord were used for the study. The specimens were collected from both normal and caesarian section of Department of Obstetrics and Gynecology in SRM Medical College Hospital and Research Center and from Government Hospital for women and children in Egmore. There were 4 groups in the study, Group 1 - Control group, women with uncomplicated pregnancy. Group 2 - Gestational hypertensive group, comprising women with blood pressure $\geq 140/90$ but no proteinuria. Group 3 - women with mild preeclampsia, had blood pressure $\geq 140/90$ and proteinuria 1+ in dip stick. Group 4 - severe preeclampsia, women with blood pressure $\geq 160/110$ and proteinuria 3+ in dip stick. Women with chronic hypertension, renal failure, cardiac problems, and multiple pregnancies were excluded.

1cm length of the cord was taken from its foetal end for the histological study. They were fixed in 10% formalin and sections were stained with H&E and Vangieson stains.

The datas were compared and evaluated by using One Way Anova, P value ≤ 0.05 was considered statistically significant. Statistical analysis was done by using SPSS version 13.

RESULTS

Table 1: Histomorphometry of Umbilical Cord

Parameter	Gr1 (control)	Gr2 (GH)	Gr3 (MPE)	Gr4 (SPE)
Amniotic Epi- Type	Simple cuboidal	S cuboidal	S cuboidal	S cuboidal
Amniotic:epi thickness	2.53 ± 0.73	2.50 ± 0.9	2.53 ± 0.71	2.51 ± 0.55
Wharton's jelly-area (mm)	35098.36 ± 8023.31	$26826.22 \pm 4704.487^*$	$25231.22 \pm 4188.064^*$	$23695.12 \pm 3689.504^{*}\#$
Area- vessel (mm^2)	10422.44 ± 2644.065	$7992.9 \pm 1507.575^*$	$6076.959 \pm 1160.14^{*}\#$	$5049.308 \pm 389.51^{*}\#\$$
Area- artery	4464.45 ± 675.40	$3872.127 \pm 917.399^*$	$3249.056 \pm 889.69^{*}\#$	$2858.477 \pm 507.293^{*}\#\$$
Area- vein	5957.98 ± 1345.01	$4120.77 \pm 1060.78^*$	$2828.90 \pm 436.53^{*}\#$	$2190.837 \pm 434.28^{*}\#\$$

*, Significant= $P < 0.05$ Control Vs GH, PE Mild, PE Severe; #, Significant, GH Vs PE Mild, PE Severe; \$, Significant, PE Mild Vs Severe

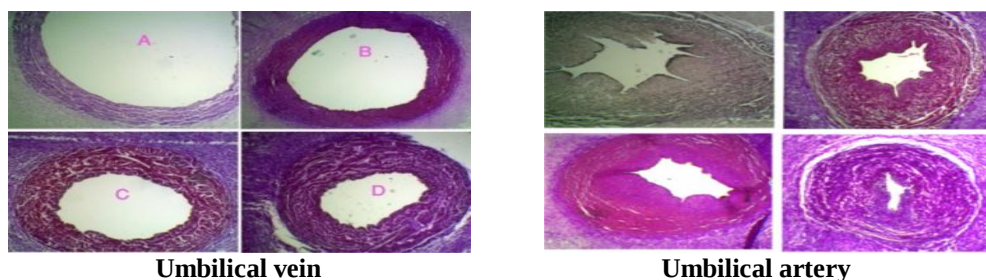


Fig 1: Umbilical Vessels: A control, B gestational hypertension, C mild preeclampsia, D severe preeclampsia

Total thickness of umbilical vessels were increased in preeclampsia, highest values were observed in severe preeclamptic group. Difference in thickness were more prominent in tunica media due to the proliferation of smooth muscles.

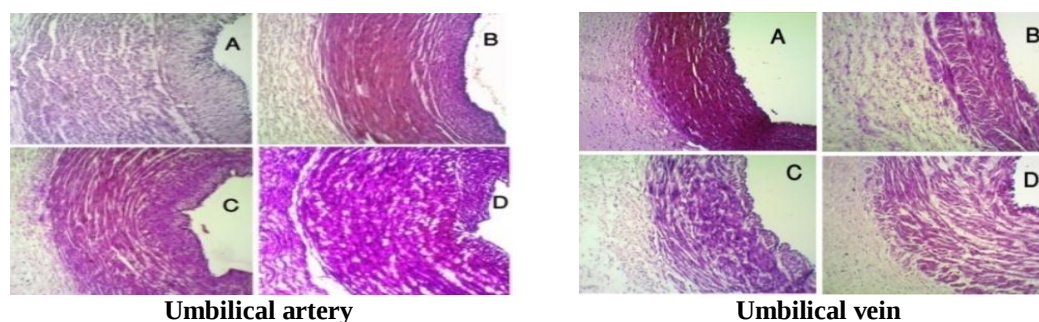


Fig 2: Layers of Umbilical Vessels

Table 2: Histomorphometry of Umbilical Vessels

Parameter	Gr1 (control)	Gr2 (GH)	Gr3 (MPE)	Gr4 (SPE)
WL ratio- artery	10.05 ± 2.77	11.01 ± 1.97	$19.77 \pm 4.68^{*}\#$	$29.99 \pm 4.79^{*}\#\$$
Total wall thickness(mm)- artery	44.92 ± 6.92	$38.63 \pm 7.82^*$	$39.86 \pm 6.15^*$	$41.36 \pm 3.63^{*}\#\$$
Intima thickness- artery	14.16 ± 3.80	$9.43 \pm 2.90^*$	$9.98 \pm 2.81^*$	$8.63 \pm 2.33^{*}\#\$$
Media thickness- artery	28.66 ± 6.69	$27.09 \pm 5.86^*$	27.77 ± 5.27	$30.56 \pm 3.66^{*}\#\$$
WL ratio- vein	1.51 ± 0.477	$2.09 \pm 0.580^*$	$2.47 \pm 0.640^{*}\#$	$2.87 \pm 0.544^{*}\#\$$
Total wall thickness- vein	25.47 ± 8.180	$23.28 \pm 6.794^*$	$29.49 \pm 4.423^{*}\#$	$31.78 \pm 6.406^{*}\#\$$
Intima thickness- vein	1.03 ± 0.157	1.08 ± 0.274	1.07 ± 0.347	1.08 ± 0.274
Media thickness- vein	23.49 ± 8.303	$21.1 \pm 6.699^*$	$27.33 \pm 4.539^{*}\#$	$29.613 \pm 6.410^{*}\#\$$

DISCUSSION

Sonographic study conducted by Raio noticed the presence of small umbilical vessels in pregnancy with hypertension, and he stated it is a marker for the adverse pregnancy outcome.^[6] Histomorphometric study of hypertensive umbilical cord conducted by Blanco MV et al also found the same. The previous studies have demonstrated changes in the structure of the umbilical vessels but these have not been correlated with the severity of disease. The structure of umbilical cord is purely dependent on the blood flow because it does not have nerve supply.^[7] Similar to the previous histomorphometric study on hypertensive cord by Barnwal et al^[8], the present study also observed the reduction in the size of umbilical vessels and Wharton's jelly in hypertension compared with the normal. These factors contribute to the thinning of umbilical cord in preeclampsia.

Wharton's jelly is a metabolically active tissue, which involved in water exchange between amniotic cavity and umbilical vessels.^[6] The most represented soluble polysaccharide in Wharton's jelly is hyaluronic acid, which can entrap large amount of water. Bankowski observed that, the hypertension is associated with significant increase of sulphated glycosaminoglycans instead of hyaluronic acid.^[9] These findings suggest that Wharton's jelly of hypertensive women is characterized by reduced hydration. So, it may be the cause for the observed thinning of cord in pre-eclampsia.^[8]

The present study also found the decreased size of umbilical vessels along with the advance of hypertensive pathology. Umbilical vessels structure has been regulated by blood flow and blood pressure.^[10-12] PIH associated placental ischemia and reduction of blood flow through the umbilical vessels might be one of the reason for the observed reduced size of vessels.

Blanco et al found the constricted lumen with increased thickness of wall and wall-lumen ratio of arteries and veins in the preeclamptic patients comparing with normal.^[13] The present study also observed the similar structural changes in both umbilical artery and vein in hypertensive condition. In contrary to this, Barnwal et al & Junek et al observed the said changes only in artery but not in vein^[8,14], whereas Koech A et al observed the greater wall thickness and a smaller luminal area in vein but no change in the structure of artery in PIH when comparing it with normal pregnancy.^[15]

According to Barnwal a persistent reduction in umbilical blood flow velocity with increasing fetoplacental impedance might induce remodeling of umbilical cord and its vessels.^[8] Bertrand et al & Biagiotti et al reported that, the situation with increased placental resistance, an increase in intra luminal pressure in umbilical artery will tend to increase compliance to keep transmural pressure relatively constant.^[16,17] The present study observed an increase in thickness of media and decrease in thickness

of intima in severe pre-eclampsia. It attributes to the migration of proliferated smooth muscle of media to the intima through splitted internal elastic lamina. This increased migration of smooth muscle cells, might represent part of the functional adaptation system of the umbilical cord arteries on the altered hemodynamic conditions in pre-eclampsia.^[14] In contrary to this, Constant Ilie found a reduction of the smooth muscular fibers of media in umbilical arteries; and the thickening of the vascular endothelium and reduction of the vascular caliber.^[18]

CONCLUSION

The present study found an extensive changes in structure of umbilical cord and its vessels in hypertensive pregnancy with different severity. These structural alteration affected the fetal outcome adversely. In accordance with the low blood flow and increased blood pressure, the umbilical vessels wall thickness also increased by the proliferation of smooth muscle cells in their media. As a response to altered hemodynamic condition, the umbilical vessels of PIH constricted more. All these changes are progressing along with its severity.

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