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Morphometry of retroplacental vessels in preeclampsia

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ABSTRACT.
Preeclampsia is a multisystemic disease with yet unknown etiology, specific only for human gestation and with symptoms like arterial hypertension, proteinuria and edema. The study group was composed by 65 pregnant women with gestational age between 38-40 weeks, which gave birth in Obstetrics and Gynecology Clinic of Constanta Emergency Clinical County Hospital, during January 2001 – July 2011 and was divided in two groups, A and B, depending on the blood pressure values measured during hospitalization. Group A was composed of 33 hypertensive pregnant women and group B was composed of 32 pregnant women with physiological pregnancy evolution. The retroplacental arterioles diameter was measured by specific methods of morphometry, the probes being obtained from myometrial tissue after caesarian section for both groups. Morphometric differences between spiral retroplacental arterioles of preeclampsia pregnant women and of those with physiological evolution during gestation certify the presence of incomplete structural parietal vessel wall changes in preeclampsia.

Keywords: preeclampsia, retroplacental arterioles, morphometry, pregnancy.

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Introduction

The modeling deficiency of spiral arterioles from retroplacental space is a consequence of extravilli trophoblastic incapacity in preeclampsia. Normal gestation is characterized by the replacement of vascular endothelium of spiral arterioles with extravilli trophoblast which invades and destroys the muscle tunica until the third internal part of myometrium, at the radial arteries origin [1,2]. These physiological changes transform retroplacental vessels in low resistance vascular pipelines, without reactivity for vasopressor treated stimuli, which allow increased maternal vascular intake in intervilli region. Decidual NK lymphocytes produce several cytokines involved in angiogenesis and vascular stabilization process (VEGF, PLGF and angiopoetine 2) and has a revolving role in trophobalstic invasion adjust and in changes of arteriolar wall in placenta [2]. There is so a deep trophoblastic invasion only for human species, probably because necessity of a longer period for cerebral structures development. In preeclampsia, these physiological changes of placental spiral arteries remain only in the decidual region, the arterial myometrial region is not being hystologically involved. About 30%-50% of placental arterioles remain anatomically intact [2].

Material and method

The study group was composed of 65 pregnant women who were hospitalized and gave birth in Obstetrics and Gynecology Clinic of Constanta Emergency Clinical County Hospital during January 2001- July 2011. Study including criteria: gestation age between 38-40 weeks (±7 days); caesarian section or delivery with complication like necessity hysterectomy in postpartum period.

Pregnant women group was divided in two groups, A and B, depending on blood pressure values measured during hospitalization. Group A was composed of 33 hypertensive pregnant women and group B of 32 pregnant women with physiological pregnancy, both groups with gestational age between 38-40 weeks (±7 days).

There were used microscopic samples colored with hemalaun-eosin. For measurements it was used Nikon E200 microscope with digital camera for images download OPTIKAM B5 with resolution 1280x1024 pixels, the camera being connected to a computer with a morphometry program OPTIKA VISION LITE.

Photos were made with OPTIKA Vision Lite 2.1 camera with a soft for linear measurements. For each case there were made measurements of 1-3 vascular structures from relevant areas which were not overlaid, at 100x magnification [3,4].

It was made a soft calibration of microscopic lens used, before measurements. The unit of measurement was the micron. The obtained values were registered in computer's program in charts, by calculating the average [5].

There were evaluated parameters like:

- Internal maximal diameter Dmax internal
- Internal minimal diameter Dmin internal.

It was necessary a statistic results interpretation because of small number of cases from the two groups. Because of absence of clinching information in medical literature, it was made a statistical analysis of obtained diameters comparing the group of preeclampsia pregnant women and group with physiological gestation. Retroplacental spiral arterioles diameters from medical literature are between 0.5 - 0.7 mm [6], 300-500 micron [7] during the second and the third trimester of pregnancy. Spiral arterioles diameters for not pregnant uterus are between 15-20 micron [7] and 200-300 micron [8]. Groups' uniformity because of gestational age (38 - 40 weeks) is the central element which allows comparing vascular diameters with a low rate error.

Results

Maximal diameter of intramyometrial retroplacental spiral arterioles situated near myometrium – basal decidua transitional area was between minimal values of 208.078 microns until maximal value of 1038.223 micron in retroplacental tissue probes obtained from preeclampsia pregnant women (Figures 1,2). Medium maximal diameter was of 639.0593 ±184.2228 micron for retroplacental spiral arterioles of group A. Median value of maximal diameter in group A was 623.2437microm.

Figure 1 - Spiral retroplacental maximal arterioles' diameter for group A and group B

Dmax	Group A	Group B
Arithmetic average	639.0593	803.7751
The standard error	20.72669	56.09041
The median	623.2437	784.3743
Module	#N/A	#N/A
Standard distortion	184.2228	350.2845
Vaulting	-0.64114	0.172272
Asymmetry	0.028914	0.397448
Amplitude's variation	830.145	1529.855
Minimal	208.078	216.9736
Maximal	1038.223	1746.829
Number of elements	79	39
Confidence interval (95.0%)	41.26367	113.5491
p	0.00054	

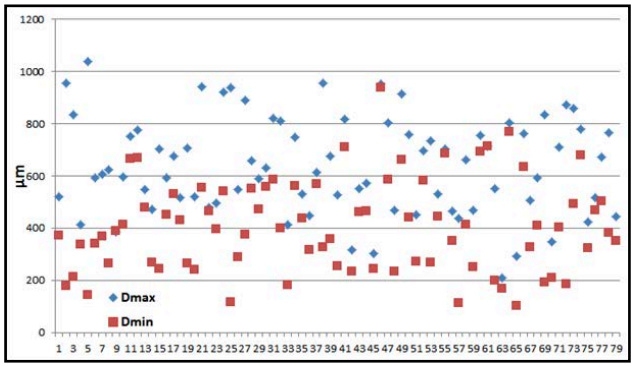

Figure 2 - Spiral retroplacental arteiroles' maximal and minimal diameters for preeclampsia pregnant women

Maximal diameter of intramyometrial spiral retroplacental arterioles was between minimal values of 216.9736 micron up to maximal value of 1746.829 micron, in retroplacental probes obtained from physiological pregnancy evolution women (Figure 3). Medium maximal diameter was 803.7751±350.2845 micron in retroplacental spiral arterioles of group B. Median value of maximal diameter in group B was 784.3743 micron. By comparing the maximal diameters of spiral retroplacental arterioles between the two groups, there were confirmed lumen changes, meaning reduced vascular diameter of spiral arterioles measured in preeclampsia pregnant women (p=0.00054).

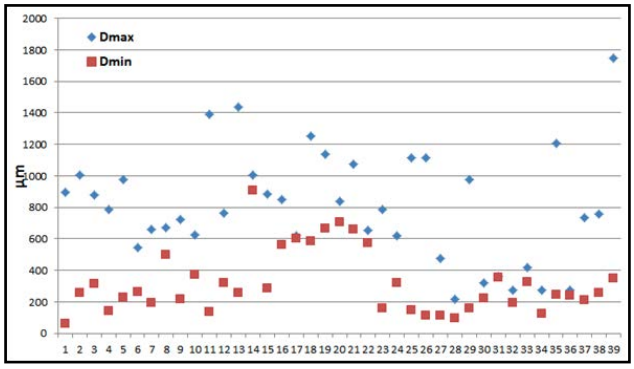

Figure 3 – Spiral retroplacental arterioles' minimal and maximal diameters for physiological evolution pregnancy group

Maximal value of minimal diameter of intramyometrial spiral retroplacental vessels was 939.4093 micron for group A and 907.1188 micron for group B (Figure 4). Minimal value of minimal diameter was 100.879 micron for group A and 63.41388 micron for group B (Figure 5). Median value of minimal diameter of retroplacental spiral arterioles was 406.8192±176.7964 micron for group A and 319.0571±200.4324 micron for group B. Median value of this minimal diameter was 396.5912 micron in group A and 255.5594 micron in group B.

Minimal diameter of spiral retroplacental arterioles of preeclampsia pregnant women is smaller than the minimal diameter of spiral arterioles of physiological pregnancy evolution women (p=0.00841).

Figure 4 – Spiral retroplacental arterioles' minimal diameter for group A and group B

Dmin	Group A	Group B
Arithmetic average	406.8192	319.0571
Standard error	19.89115	32.09486
The median	396.5912	255.5594
Module	#N/A	255.5594
Standard distortion	176.7964	200.4324
Vaulting	-0.15016	0.709405
Asymmetry	0.475294	1.14938
Amplitude's variation	838.5303	843.7049
Minimal	100.879	63.41388
Maximal	939.4093	907.1188
Number of elements	79	39
Confidence interval (95.0%)	39.60024	64.97265
p	0.00841	

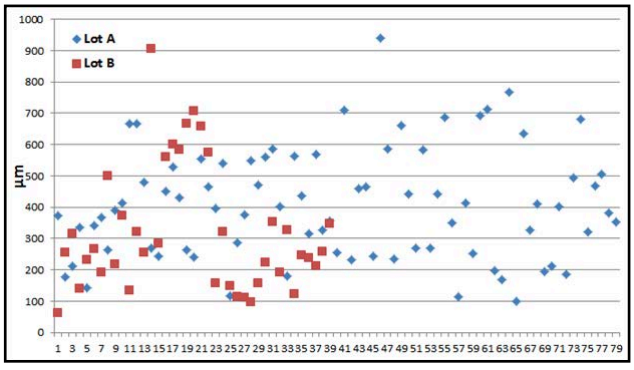

Figure 5 – Minimal diameter values for the two groups

Discussions

I believe that these findings contrary to expected vascular model are explained by:

• Essential changes affect spiral arterioles by infiltrating them by trophoblastic cells up to the third internal part of myometrium for physiological pregnancy evolution women (group B)

• Middle arteriolar tunica is transformed by trophoblastic and hyaline tissue which transforms the retroplacental spiral arteriole in a large vascular pipeline, without capacity for vasoconstrictor reaction for vasopressor stimuli and which can be modified by juxtavascular myometrial pressure for physiological pregnancy evolution women (group B)

• Changes in geometry and vascular structure of spiral arterioles determine their progressive transformation in high flow and low resistivity vessels without vasopressor stimuli answer

• These physiological changes of spiral arterioles during normal evolution pregnancy, with normal placentation model [9], are significantly reduced in pregnancies with preeclampsia (group A)

• Preeclampsia retroplacental spiral arteriole (group A) remains with muscular tunica in the third internal area of retroplacental myometrium, responds to vasopressor stimuli and has small vascular geometry changes [10], so the minimal diameter is less or not at all modified by juxtavascular myometrial pressure.

Conclusions

1. Morphometric differences between retroplacental spiral arterioles of preeclampsia pregnant women and of those with physiological evolution pregnant women confirms the structural vascular parietal changes in preeclampsia.
2. Growth deficiency of vascular section of retroplacental spiral arterioles area in preeclampsia.

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