

# Changes in Morphometric Indicators of the Placenta Depending on the Severity of Pre-Eclampsia

Rakhmanova Nodira Khodjayazovna<sup>1</sup>, Kattakhodzhaeva Maxmuda Khamdamovna<sup>2</sup>,  
Jumaniyazova Khulkar Atabayevna<sup>1</sup>

<sup>1</sup>Urgench Branch of the Tashkent Medical Academy, Department "Obstetrics and Gynecology", Urgench, Uzbekistan

<sup>2</sup>DSc. Professor, Tashkent State Dental Institute Department "Obstetrics and Gynecology", Tashkent, Uzbekistan

**Abstract** The diagnosis and management of hypertension disorders in pregnant women, along with associated consequences, get particular attention worldwide. In contemporary medicine, postpartum consequences in women with preeclampsia or eclampsia constitute a critical issue. Innovative methodologies, including the use of clinical and pathomorphological tools, are required in the study of all connections in the mother-placenta-fetus system in order to solve problems connected to maintaining the life and health of the mother and child.

**Keywords** Preeclampsia, Eclampsia, Placenta, Mother-placenta-fetus system, Antenatal diagnosis

## 1. Topicality of the Thesis

Preeclampsia (PE) is characterized by systemic inflammation, oxidative stress, and changes in the levels of angiogenic factors and vascular reactivity. These changes are exacerbated in normal pregnancy and are linked to a disorder of compensatory mechanisms that ultimately results in placental and vascular dysfunction. The placenta is a unique organ that develops and differentiates, affecting fetal growth and the mother's condition throughout pregnancy [1].

Since PE may only occur when placental tissue is present in the body and is nearly always resolved upon removal, the placenta is crucial to the pathophysiology of the disease. When placental antiangiogenic substances reach the mother's bloodstream, they damage and disrupt the endothelium. Arterial hypertension, proteinuria, glomerular endotheliosis, HELLP syndrome, and PE may result from this [2].

## 2. Aim of the Study

Using cutting-edge research techniques (scanning and atomic force electron microscopy) to examine the pathomorphological characteristics of the placenta in pregnant women with PE in order to identify strategies for reducing neonatal morbidity and mortality.

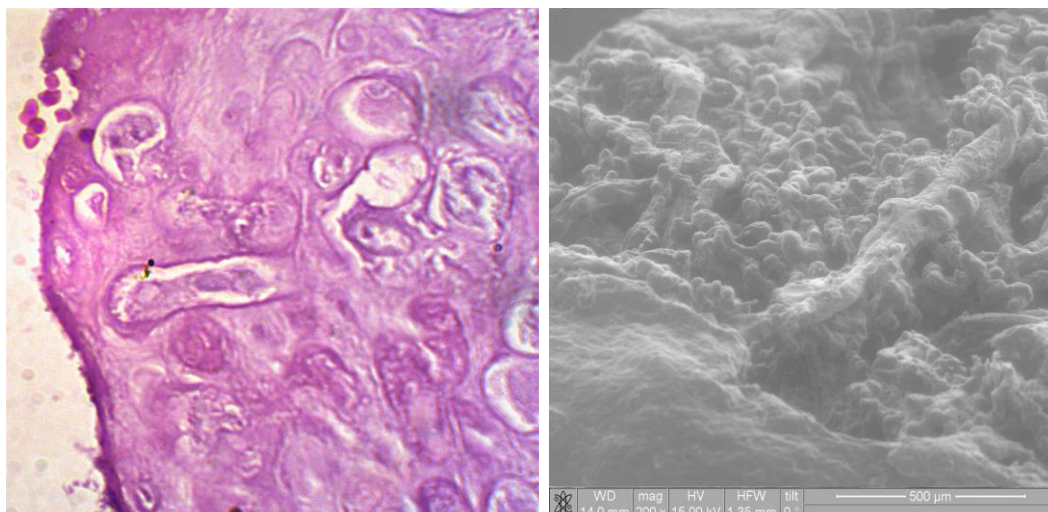
## 3. Materials and Methods

The placentas of 25 women with PE (15 with moderate and 10 with severe PE) were studied. The samples were taken from the central, paracentral and peripheral parts of the organ. For subsequent analysis to implement the light-optical study, the samples were fixed in 10% neutral buffered formalin, then embedded in paraffin and sections were made from the blocks on a microtome, which were then stained with eosin and hematoxylin in the standard manner. Their photography was performed in a Topic-T Ceti microscope. Additionally, a morphometric study was carried out using the standard Video-Test Size software.

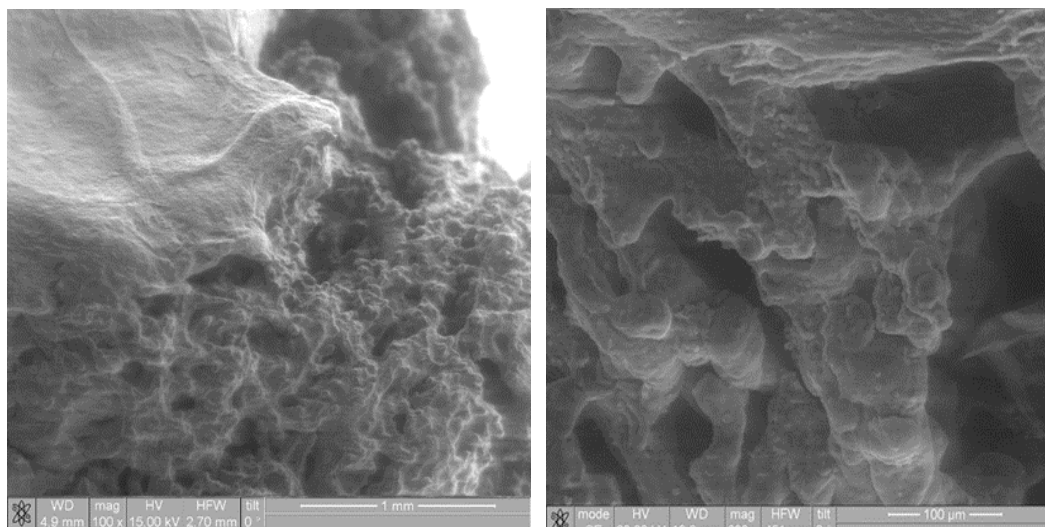
For electron scanning microscopy, the samples were washed at 37°C in several portions of sodium chloride in the form of an isotonic solution. Then, at the same temperature, they were dipped into a fixation mixture consisting of glutaraldehyde (2% in phosphate buffer) and kept for two days in a refrigerator. After that, the objects were analyzed and photographed in microscopes: "FE1 Quanta 200 3D", as well as "FE1 Quanta 600 FEG".

## 4. Results and Discussion

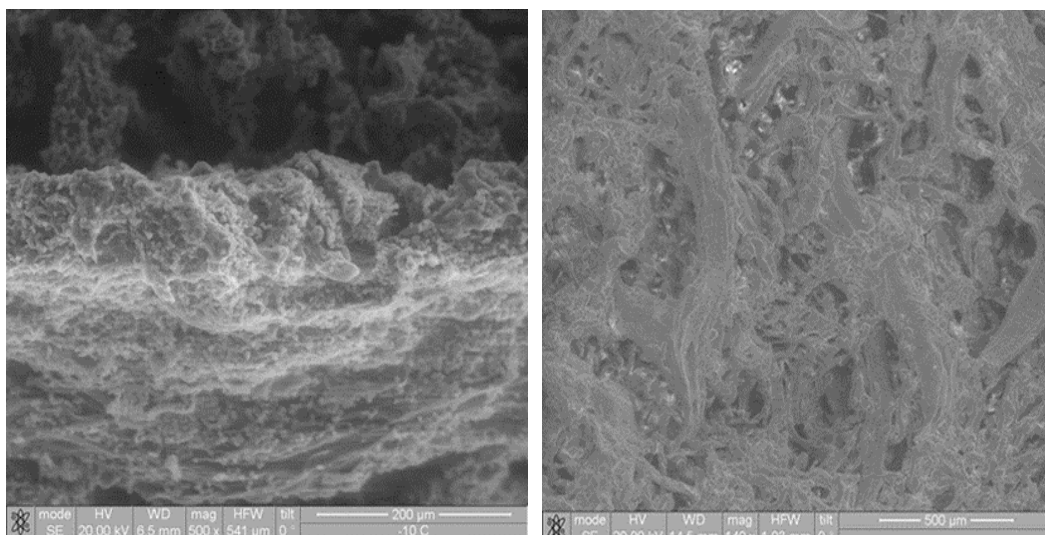
In preeclampsia in the mother, the proportion of the placenta area occupied by large infarcts, both white (with a long history) and red, hematomas, massive intervillous thrombi, afunctional zones, caverns, calcifications (Fig. 1) increased significantly. The presence of pathologically altered fragments depended not only on the severity of the disease in the mother, but also on its duration, as well as on the options for fetal life.



**Figure 1.** Fragments of the placenta in a woman with severe preeclampsia. Fragments of infarctions (A, B). Afunctional zones with pathological convergence of villi (B). Fig. A (x400). Light microscopy. Hematoxylin and eosin staining Fig. B (x200). Scanning electron microscopy

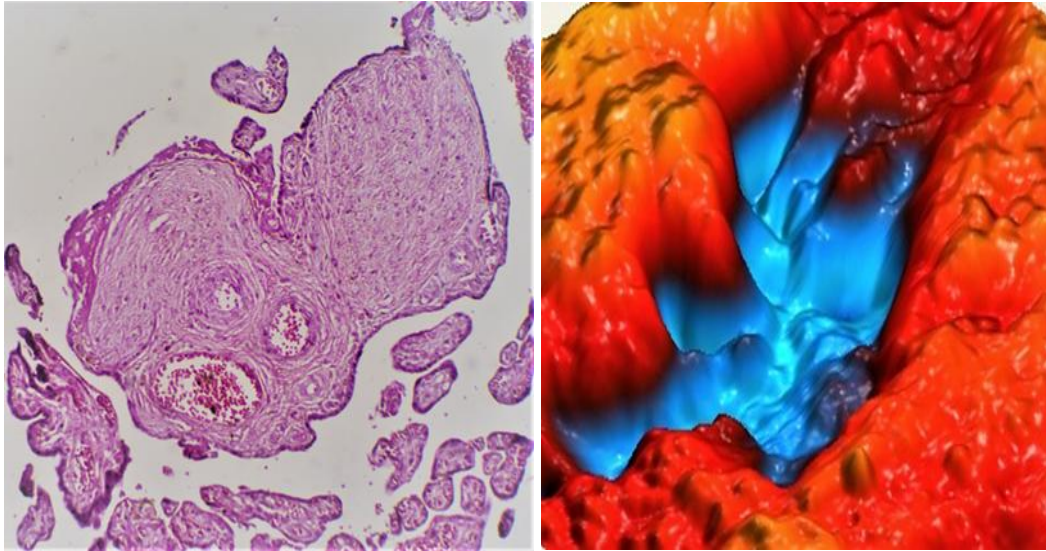


**Figure 2.** Fragments of the placenta in moderate preeclampsia. The fetal surface and villous tree with a predominance of stem and intermediate villi (A, B). Fig. B (x600) fragment of Fig. A (x100)

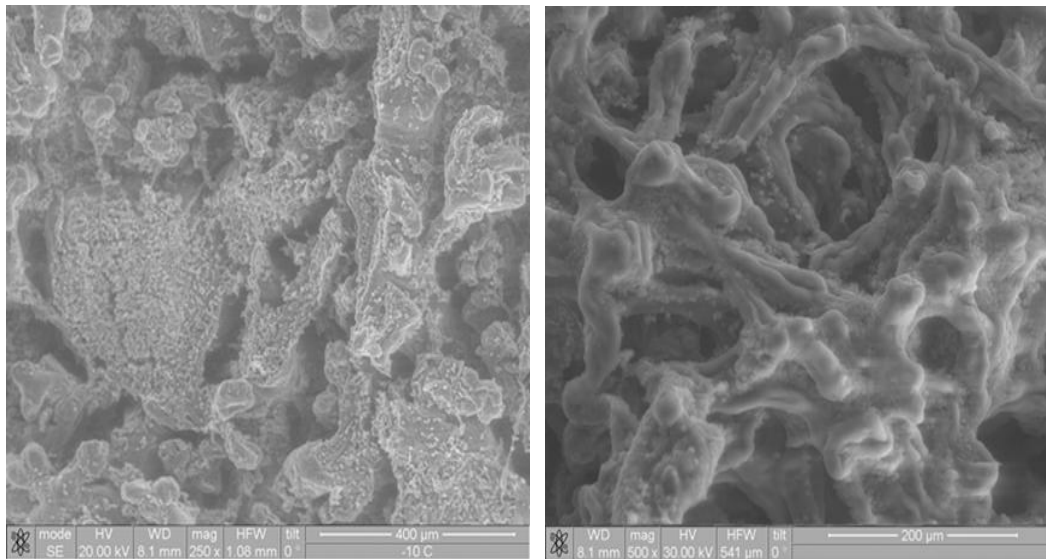


**Figure 3.** Fragments of the placenta in moderate preeclampsia. Maternal surface with edema and sclerosis (A). The fetal surface and villous tree with predominance of stem and intermediate villi (A, B). Fig. A (x500), Fig. B (x140). Scanning electron microscopy

The villous tree plays a key role in the exchange, protective and immune mechanisms in the placenta. In this regard, when studying its microstructural features, we paid particular attention to it. A study was conducted in all its morphological components: stem, intermediate and terminal villi (Fig. 4, 5).



**Figure 4.** Fragments of the placenta in moderate preeclampsia. The stem villi in individual cotyledons are sclerosed (A), including their vascular wall (A, B). Fig. A (x100). Light microscopy. Hematoxylin and eosin staining Fig. B. Atomic force microscopy, 3D image (x1000)



**Figure 5.** Fragments of the placenta in moderate preeclampsia. The stem villi in individual cotyledons are full-blooded (A). The proportion of intermediate villi is significantly increased (B). Fig. A (x250), Fig. B (x500). Scanning electron microscopy

**Table 1.** Morphometric parameters of placentas in pregnant women with preeclampsia of varying severity (%)

Observation groups	Specific area (%)			
	Villous tree	Syncytial Kidneys	Intervillous space	Intervillous fibrinoid
Preeclampsia (moderately expressed)	55, 0±3,1 *	2,1±0,2*	36,8±1,8*	6,1 ±0,9 *
Preeclampsia (heavy)	50, 5±3,5* **	1,2±0,1* **	40,0±2,6* **	8,3 ±0,6* **
Control group	62, 5±3,2	2,9±0,8	31,3±2,7	3,3 ±0,6

Appendix. \*p<0.05 compared to the control group \*\*

\*\*p<0.05 in comparison with groups of different severity of preeclampsia

In the villi themselves, it was important to study its constituent components (the specific area of the villous tree and syncytial nodules on it, as an indicator of regeneration, in

relation to the inter-villous space with fibrinoid in it), presented in Table 1, Figure 5.

In the study of morphometric indices of placentas in

pregnant women with preeclampsia of varying severity, we showed that in complicated pregnancies we observed a decrease in the area of the villous tree with syncytial buds (Table 1) on the surface of its terminal section with a corresponding redistribution of its share to the inter-villous space with an increased location of fibrinoids in it. These indices directly depended on the severity of the disease ( $p < 0.05$ ).

The changes detected in the placenta indicate a significant disruption of its functions (hemoplacental barrier, gas exchange, trophic, excretory); to an even greater extent than was shown by standard research methods. This must be taken into account by clinicians to preserve the vital functions of the fetus and newborn.

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