Impact Factor: 9.9 ISSN-L: 2544-980X

Morphological Characteristics of the Umbilical Cord in Pregnant Women with Fetoplacental Insufficiency: Diagnostic Significance

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Abstract: Evaluation of maternal-placental-fetal blood flow in mild preterm placental abruption (PNA) compared with placental tissue morphological characteristics.

Materials and methods. 82 pregnant women with mild PONRP (comparison group) and 15 healthy pregnant women (control group) were examined.

Results. Assessment of utero-placental-fetal blood flow in pregnant women with mild PONRP is characterized by a significant increase in the systolic-diastolic ratio (SDR) and resistance index (RI) in the uterine arteries. No significant differences were found between primiparous and multiparous women. Morphological characteristics of the placenta in primiparous women are characterized by more pronounced dystrophic, hemodynamic and inflammatory changes than in multiparous pregnant women with mild PONRP, which indicates a decrease in the compensatory and adaptive capacity of uteroplacental blood flow.

Summary. Doppler examination of uteroplacental-fetal blood flow is necessary for mild PONRP. It makes it possible to assess the severity of hemodynamic disorders in the myometrium, to assess the condition of the fetus, in which case it is impossible to choose the correct and timely pregnancy management tactics.

Key words: premature separation of a normally located placenta, Doppler ultrasound examination of fetoplacental blood flow, morphology of the placenta.

Premature abruption of the normally placed placenta (PNAP) is a very important and urgent problem. Despite many scientific studies devoted to this problem, serious and often fatal complications of pregnancy are very common in practice. Thus, PONRP ranks first among the causes of maternal death, perinatal death 25%, stillbirth 41.3-55.2% [1-3].

Today, many researchers agree that hemodynamic disturbances in the mother-placental-fetal system, disturbances in the hemostasis system lead to morphofunctional disorders of the placenta (placental hypoplasia, dystrophic changes, spasm and obliteration of blood vessels, microthrombosis, calcification, and infarctions) and the development of various pathological conditions of the placenta. pathogenetic mechanism: placental insufficiency, PONRP, fetal growth restriction syndrome, etc. [3-7].

The issues of forecasting and development of diagnostic criteria for the development of PONRP have not been resolved to date. In this regard, it is relevant and necessary to evaluate the condition of the blood flow in the fetoplacental system as a clinical indicator for assessing the condition of the fetus in comparison with the morphological characteristics of the placental tissue in PONRP.

The aim of our study was to evaluate maternal-placental-fetal blood flow in mild PONRP compared with placental tissue morphological characteristics.

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Materials and research methods

A total of 97 pregnant women were examined during the period of 32-40 weeks of pregnancy. Thus, 82 pregnant women with mild PONRP (comparison group: 1 - 42 primiparous, 2 - 40 multiparous) and 15 healthy pregnant women (control group) had a clinical picture.

The criteria for inclusion in the study were a mild clinical manifestation of PONRP, the absence of severe somatic diseases, uterine tumors, abnormalities in the development of the uterus, the absence of antibodies to Rh factor or group incompatibility, and the presence of voluntary consent to participate. study

Ultrasound and Doppler studies of uteroplacental-fetal blood flow were performed using a real-mode LOGIQ 400 CL device with a 3 MHz sensor.

Fetometry and placentometry were performed, and fetal amniotic fluid volume and blood flow in both uterine arteries as well as the umbilical arteries and middle cerebral artery were assessed. Systolic-diastolic ratio (SDR) and resistance index (RI) were determined for each vessel.

Morphological study of the placenta was carried out according to the standard method: pieces of the placenta were fixed in a 10% solution of neutral formaldehyde, subjected to dehydration in increasing concentrations of ethyl alcohol and placed in paraffin blocks. Then, 5-μm-thick sections were cut, stained with hematoxylin-eosin, and viewed under a Carl-Lessjena light microscope (Germany). Pieces of the placenta were taken from different places (at least 4): from the site of separation, from the central and peripheral parts of the surface of the placenta.

Research results and discussion

The average age of pregnant women was 26.0±1.6 years. Assessment of somatic diseases in groups 1 and 2 showed that iron deficiency anemia in pregnant women 54 (65.9%), thyroid diseases - 27 (32.9%), chronic tonsillitis - 12 (14.6%), urine tract infections - 9 (11%), digestive obesity - 4 (4.9%), varicose veins - 3 (3.7%). The frequency of somatic diseases in multiparous women is 1.2 times higher than in primiparous women. There are 12 (14.6%) healthy women among those examined, and 2.5 times more in group 1 than in group 2. The diagnosis of mild PONRP was made on the basis of clinical data, ultrasound examination of the uterus, placenta and fetus, and Doppler examination of blood flow in the uterine arteries, umbilical arteries and middle cerebral artery of both sides. in the fetus.

It is noteworthy that among pregnant women with PONRP, 20 (24.4%) patients had pelvic inflammatory disease. In addition, there were 37 (45.1%) carriers of infections such as chlamydia, cytomegalovirus, and herpes simplex virus. Thus, 23 (54.8%) of these infections were detected among primiparous women, 19 (47.5%) among multiparous women.

Pregnancy occurred in 39 (47.6%) women with PONRP against the background of risk of abortion. Thus, the threat occurred in 18 (22%) women in the first half of pregnancy, and in 21 (25.6%) women in the second half. 29 (69.0%) primiparous women and 10 (25%) multiparous women had a risk of miscarriage. Transverse position of the fetus with PONRP occurred in 3 (3.7%), complete view of the fetus - in 2 (2.4%) pregnant women. Fetoplacental insufficiency was present in 19 (23.2%) patients. In addition, this complication is more frequent in both groups 1 and 2 (23.8 and 22.5%, respectively).

It is noteworthy that 35 (42.7%) women with PONRP during pregnancy had an exacerbation of respiratory diseases (acute respiratory infections, pneumonia) and 5 (6.1%) chronic pyelonephritis. It should be noted that respiratory diseases occurred in 20 primiparas (47.6%), exacerbation of chronic pyelonephritis - in 3 (7.1%), and in multiparas in 15 (37.5%) and 2 (5%), respectively. Pregnancy vomiting occurred in 32 (39%) women with PONRP, in group 1 - 18 (42.9%), in group 2 - 14 (35%).

Mild PONRP occurred in 53 (64.6%) nulliparous women, 16 (19.5%) in the latent phase, and 13 (15.9%) during labor. Thus, PONRP occurred in 11 (13.4%) women in the first stage of labor, in 2 (2.4%) women in the second stage. In addition, in 2 (2.4%) pregnant women, PONRP was induced by

induction of labor with oxytocin. Premature rupture of amniotic fluid was observed in 3 (3.7%) pregnant women.

Determination of blood group showed that 0 (I) blood group was present in 24 (29.3%) women, A (II) - 27 (32.9%), B (III) - 21 (25.6%), AB (IV) - at 10 (12.2%). Rh-negative blood in 7 (8.5%) pregnant women, in group 1 - 4 (9.5%), in group 2 - 3 (7.5%).

Delivery was urgent in 63 (76.8%) women with PONRP, premature in 16 (19.5%), delayed in 3 (3.7%). All deliveries completed promptly. Thus, 97.6% of pregnant women were born by cesarean section, 2.4% of women had obstetric forceps used. In order to stop bleeding, 6 (7.3 percent) underwent subtotal hysterectomy of the uterus without appendages, and 21 (25.6 percent) pregnant women underwent additional ligation of two pairs of large vessels for the purpose of hemostasis. At the same time, in 92.7% of pregnant women, the volume of blood loss is up to 1000 ml, in 7.3% - from 1000 to 1500 ml.

The location of the placenta was determined by ultrasound in 45 (54.9%) pregnant women, the placenta was located on the front wall of the uterus, in 37 (45.1%) on the back wall of the uterus, and on the right in 44. (53.7%), on the left - 38 (46.3%).

Our research showed that pregnant women with PONRP had high rates of anemia (65.9%) and thyroid disease (32.9%). In addition, no significant differences were found between these diseases in both groups. It is noteworthy that almost half of pregnant women have a sexually transmitted infection; Every fourth woman has inflammatory diseases of the genital organs. I would also like to note that 42.7% of pregnant women had a viral or viral-bacterial infection of the respiratory system, and 6.1% had an increase in urinary tract infection.

Pregnancy loss occurred most often (39%) against the background of toxicosis (vomiting) in the first half of pregnancy, as well as against the background of the threat of termination of pregnancy in the first and second half, which occurred in almost half of women. with PONRP. In addition, the risk of pregnancy in the group of primiparous women was three times higher than that of multiparous women. According to VE. Radzinsky and others. [2], in pregnant women with PONRP, as in our study, varying degrees of anemia, early toxicosis and the threat of termination of the first and second half of pregnancy are common.

Evaluation of the pathogenetic mechanisms of the occurrence of PONRP shows the leading role of hypertensive myometrial dysfunction, the main cause of which is the morphological and functional failure of the myometrial segments of the uteroplacental arteries. The appearance of signs of possible thrombus formation in the vessels of the uteroplacental blood circulation and interspinal space in the body of women should be considered as signs of readiness to initiate pathological reactions of the PONRP process. First of all, it requires the control of the tone of the myometrium, which changes can be evaluated by the increase in blood flow resistance in the uterine arteries [3].

Assessment of uteroplacental-fetal blood flow showed the following. In pregnant women of groups 1 and 2, SDO and IR in both uterine arteries increased significantly compared to the control group. However, the difference between these indicators on the right and left was not determined. No significant changes in fetal vasculature were observed when compared with control or comparison groups. There was no difference in SDO and IR indicators depending on birth parity (table).

Currently, many authors agree that using a non-invasive diagnostic method - Doppler ultrasound, it is possible to monitor hemodynamic processes in the placenta and detect the early stages of placental blood flow disorders [8-11]. MS Zaynullina [1] showed the presence of hemodynamic disturbances in the uteroplacental system with PONRP and trophoblast invasion with incomplete decidual remodeling of the uteroplacental arteries.

In studies of VE. Radzinsky and others. [2] found a significant increase in vascular resistance in the spiral arteries during PONRP, both in the periphery and in the central part of the placental site. An increase in SDO and IR in uterine arteries and umbilical arteries has also been found in cases of fetoplacental insufficiency, fetal growth restriction syndrome, and preeclampsia [6, 9, 10].

It can be seen that sometimes the passing of the clinical picture and massive bleeding in PONRP do not allow to perform a number of diagnostic manipulations. In cases of mild PONRP, a functional evaluation of the fetoplacental complex is necessary, which ensures the correct choice of pregnancy management tactics at this stage. Our studies showed an increase in SDO and IR in uterine arteries. This probably indicates a retroplacental hematoma or a spasm of the uterine artery caused by an increase in intrauterine pressure that develops as the area of the separated placenta grows. A similar picture is MS Zainullina [1] in PONRP.

Perhaps, the absence of significant changes in SDO and IR indicators in the vessels of the fetus with mild PONRP can be considered a manifestation of the compensatory ability of the utero-fetal-placental blood flow, which performs protective and adaptive reactions during pregnancy complications. to ensure adequate blood circulation in the fetus until the adaptive mechanisms fail.

In the literature, there is an opinion that preclinical signs of the formation of fetal growth restriction syndrome may be an increase in SDO in the artery on the side of the placenta after 23 weeks and in the umbilical artery after 22 weeks of pregnancy [9]. In the presence of fetoplacental insufficiency in both uterine arteries and umbilical arteries, IR indicators increase, which is associated with the severity of hemodynamic disturbance of the fetoplacental complex in fetoplacental insufficiency [6].

Microscopic examination of the placenta of primiparous women with PONRP showed thickening of blood vessel walls with stenosis and thrombosis, a decrease in the number of terminal and intermediate villi with expansion of the villous cavity. Decidua composed of loose decidual cells with connective tissue fibers, less cytoplasm, swelling, and subepithelial layer is covered with syncytiotrophoblast, and the syncytiotrophoblast layer is thinned with small pieces of fibrinoid material. noted.

Morphometric studies of placental biopsies of primiparous women with PONRP showed a decrease in the number of intermediate villi in the field of vision to 90-100, and terminal villi to 20-30. The thickness of the vessel walls reached 160-180 microns with clear lymphoid infiltration. Thinning of the syncytiotrophoblast layer to 7-8 μm was noted, while in multiparous women this layer was 10-12 μm. A decrease in the number of decidual cells to 180-200 microns was also found, they participate in the formation of fibrinoid substance, on the one hand, they separate the embryo from the maternal environment, and on the other hand, they prevent trophoblastic invasion of the decidua. A small accumulation of syncytial buds in the terminal villi, small pieces of fibrinoid substance in the intervillous space, and the presence of erythrocytes in the vessels were noted.

Light-optical examination of the placenta of multiparous women with PONRP showed numerous terminal and intermediate villi with a narrow intervillous space with numerous capillaries. Decidua consists of a polygonal shape of light cytoplasm of decidua cells surrounded by collagen reticular fibers, trophoblast villi, eosinophilic material - a thick fibrinoid layer.

In the intervillous space, degenerative structures are visible, along with terminal villi covered with multinucleated syncytiotrophoblast cells. In the middle of the villi, many vessels are visible, covered with a layer of endothelial cells, as well as trophoblast cells with an enlarged lumen. Single subepithelial cytotrophoblast cells are also present.

Morphometric studies of histological preparations of the placenta of multiparous women with PONRP showed that the number of intermediate villi in the visual field is 140-150, terminal villi - 50-60, the diameter of vessels is 220-230 μm, and the thickness of their walls 15-25 μm. The number of decidual cells reaches 250-300. At the same time, a slight increase in the number of cytotrophoblast cells, which together with decidual cells play an important role in preventing the development of transplant immunity, was noted.

Morphological studies have shown some structural changes in the placenta in primiparous women with PONRP. First, the decrease in the amount of fibrinoid substance in the inter-fork space, which determines the barrier function of the fetus against the immune aggression of the mother's body. Secondly, stenosis of the lumen of thrombosed vessels, a decrease in the number of trophoblast-type

cells in the terminal sections of spiral arteries leads to microcirculation, hemodynamic changes, and then placental abruption in primiparous women.

Morphometric studies revealed quantitative changes in lumen diameter and thickness of blood vessel walls, terminal and intermediate villi, decidual and trophoblastic cells in primiparous women with PONRP, which may have a negative impact on fetal development.

It should be said that the assessment of the relationship between the morphological assessment of the placenta and the state of hemodynamics in the fetoplacental and uteroplacental complex has been reflected in many studies [8, 12]. The peculiarity of the morphological assessment of the placenta in primiparous women is that compensatory and adaptive reactions are significantly less common in this category of pregnant women, and pathological reactions characterized by various dystrophic, hemodynamic and inflammatory changes are more common. multiparous women [13].

In the works of IS. Sidorova and others. [14] also noted a violation of the invasive activity of the cytotrophoblast and defective transformation of the small arteries of the uterus, which is characteristic not only of preeclampsia, but also of other obstetric syndromes.

Our research is also consistent with these data: the morphological features of the placenta in primiparous women are characterized by more pronounced dystrophic, hemodynamic and inflammatory changes than in multiparous pregnant women with mild PONRP, which indicates compensation and adaptation of the uteroplacental complex. indicates a decrease in ability.

Thus, based on the above, the following conclusions can be drawn:

Inflammatory diseases of the genitals and sexually transmitted infections contribute to the occurrence of PONRP during pregnancy. The frequency of these diseases is the same in primiparous and multiparous women.

Toxicosis (vomiting) in the first half of pregnancy and the threat of termination of the first and second half of pregnancy are a favorable background for the development of PONRP. In primiparous women, the risk of miscarriage is 3 times higher.

Assessment of uteroplacental blood flow in pregnant women with mild PONRP is characterized by a significant increase in SDO and IR in the uterine arteries. In addition, no significant differences were found between primiparous and multiparous women.

Morphological changes in the placenta in primiparous women are characterized by more pronounced dystrophic, hemodynamic and inflammatory changes in the placenta, which indicate a decrease in compensatory and adaptive abilities.

Summary

For mild PONRP, doppler examination of the uteroplacental-fetal blood flow and ultrasound examination of the pregnant uterus are necessary. It makes it possible to assess the severity of hemodynamic disturbances in the myometrium and fetus, to determine the size of the uteroplacental hematoma, as well as to assess the condition of the fetus, in which case it is impossible to choose the correct and timely pregnancy management tactics. Timely diagnosis and correctly selected tactics for mild PONRP can reduce the frequency of massive bleeding and, accordingly, prevent all further complications. Research results confirm the need for morphological evaluation of the placenta, which substantiates the depth of functional disorders in the fetoplacental complex [7, 15].

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